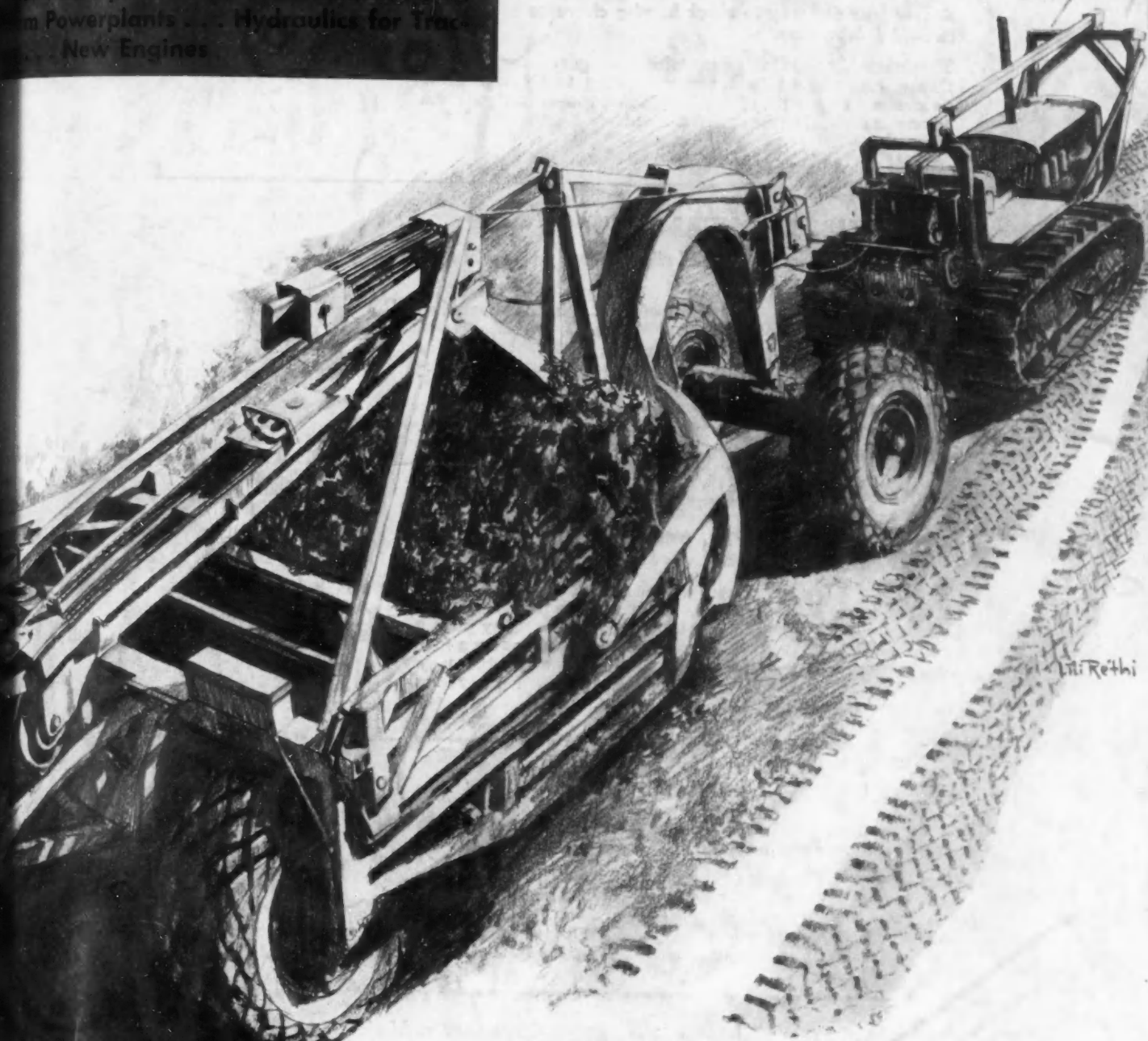


SAE JOURNAL

SEP 10 1947

This Issue: "Making the Most of Engineering"
Plastic Cars . . . Symposium on
Age (digest) . . . Airliner Seats . . . Helicopter
Powerplants . . . Transmissions . . . Helicopter
Powerplants . . . Hydraulics for Tracked
New Engines



September 1947



Rumor Page



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A new precision way to check bearing clearance saves up to two-thirds labor time.

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A leading bus manufacturer is building a bus that steers from both ends.

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Contributed by James Boothroy, Jr. Buffalo, N. Y.



IT'S RUMORED THAT

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IT'S RUMORED THAT

At 20 miles per hour it takes longer to get your foot on the brake than it does to stop the car!

True. Reaction time for the average driver is such that the car goes 22 feet from the time he decides to stop until he gets his foot on the brake. It travels 21 feet after the brake is on. Incidentally, two drinks and the average driver takes twice as long to start to stop—and a lot can happen in that time!



Perfect Circle Corporation, makers of Perfect Circle Custom Made Piston Ring Sets, will pay fifty dollars (\$50) for each rumor, fact or fiction, accepted for this page. Send your rumor to Rumor Page, Perfect Circle, Hagerstown 9, Indiana. All contributions become our property and cannot be returned or acknowledged.

The Cover

● Earth-moving equipment, such as the tracklayer and the equipment it hauls across our front cover, has become an integral part of the nation's economy. Speedy construction of highways, dams, and excavations for buildings for industrial America depends on specially designed equipment, either self-powered or operated by standard models of tractors such as the unit pictured. After a battle-scarred record of dramatic service with the armed forces, earth movers have returned to civilian duty the world over.

For the Sake of Argument

By NORMAN G. SHIDLE

The obvious retort to "Who does he think he is!" is "Who do you think you are!" Which leaves both parties right where they started – and bystanders giving answers to both exclamatory queries which neither principal would like.

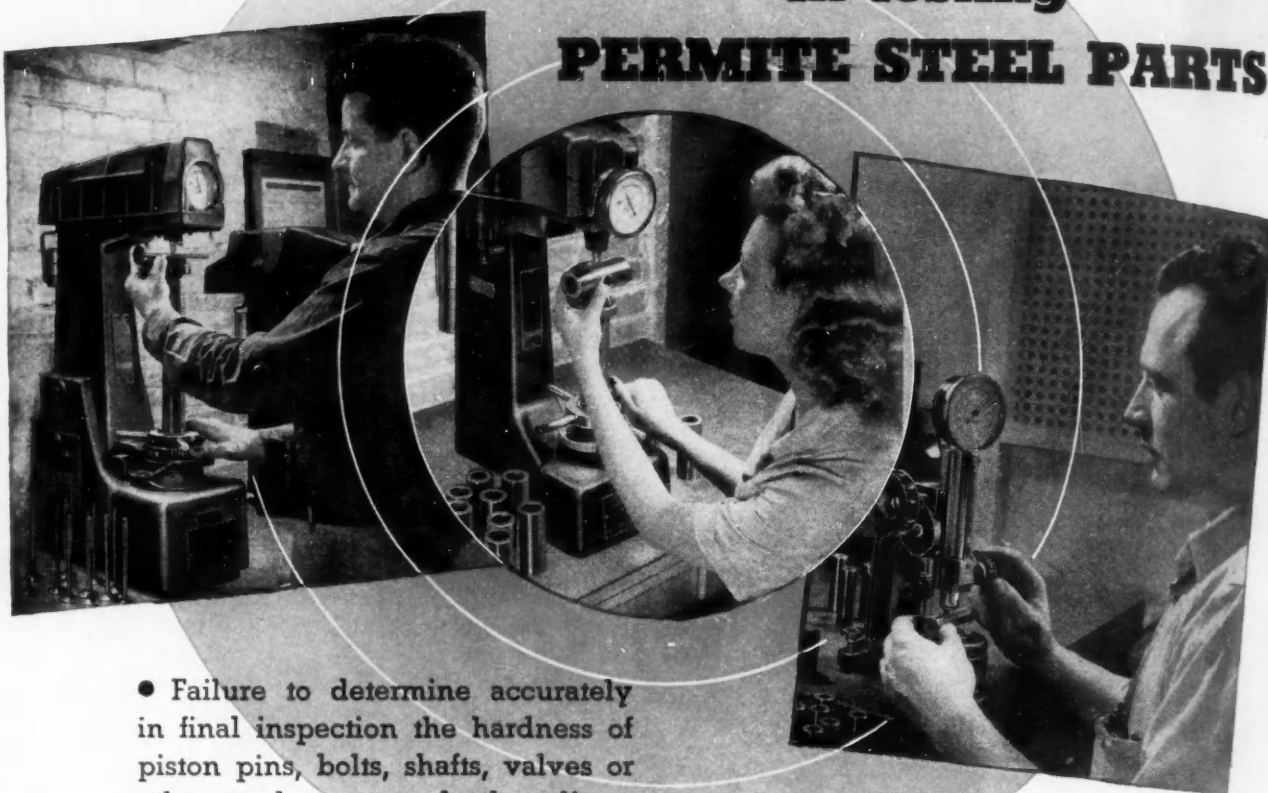
The less assured an associate is, the more likely he is to ask such a question in the first place – or to hand it back when faced with it. Understanding breeds tranquillity, assurance; inferiority complexes, disputatiousness.

A good deal of "who-does-he-think-he-is" thinking goes on that never finds expression in words. It produces the same results as if spoken, though possibly in lesser degree. It is particularly common among competent people; people who usually are right . . . and hurts seriously the chance to get their right thinking into the minds of others where it can gain wider application in practice.

Understanding people swallow emotional challenges as a wave envelopes a stick – without pausing in their onward course. Small men stop to fight non-essential battles wherever and whenever they find them – wasting their own and everybody else's energy in the process.

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SAE JOURNAL

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54th & Chestnut Sts.
Philadelphia 39, Pa.

EDITORIAL OFFICE

29 West 39th St.
New York 18, N. Y.
Tel.: Longacre 5-7174

ADVERTISING OFFICES

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1948 SAE Handbook

SAE Council has decided that the 1948 SAE Handbook will be sent only to those who order it. It will be free to members as usual. (To order, just check as indicated on your dues bill for the 1947-48 fiscal year.)

Reason for changed procedure: "To avoid waste; save expense."

REMEMBER THIS?

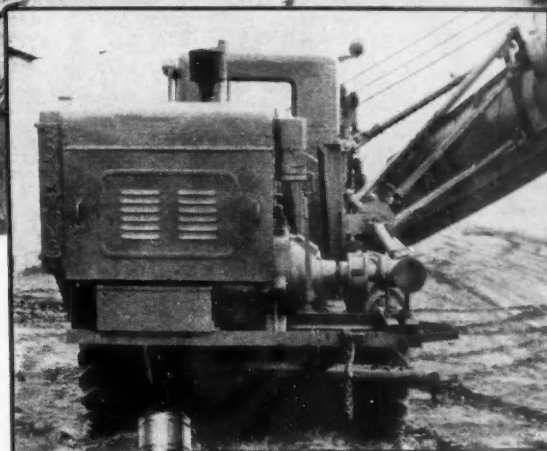


January 29, 1947

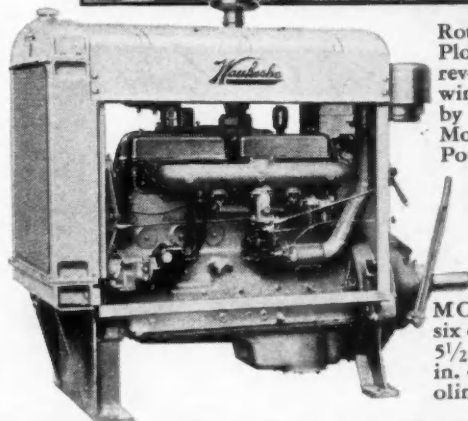
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● Get ready for Old Man Winter *now!* Put Waukesha power behind your snow removal equipment. Keep those streets and highways *open!* The snow plow shown is a Roto Wing. Waukesha powered, it goes through 2-3 ft. drifts throwing snow at 20 m.p.h. On the highways it cuts deeper than 3-ft. snow banks back 5 ft. beyond the road shoulder. And what a power plant it has! 7-bearing, 3 $\frac{1}{4}$ in. drop-forged, heat-treated steel crankshaft . . . precision type bearing shells . . . hard alloy valve seat inserts . . . removable wet-type cylinder sleeves . . . thermostat controlled cooling . . . gear driven oil and water pumps . . . Waukesha built-in governor. Get Bulletin 1223.

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MAKING the most of ENGINEERING

James C. Zeder
Chairman, Engineering Board
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AS engineers, our individual success is measured not only by how much we know, but, of even greater importance, by how much of our information we can pass on to others and how much of it gets into actual use.

That, in turn, depends upon something more than an ability to solve technical problems. We must match that with an equal ability to make progress in fields beyond technology, so that our knowledge and experience can have practical application. More often than not, our real progress depends on how well we tackle the non-technical obstacles that frequently get in our way.

Yet, it is these non-technical obstacles that seriously bother us — that confront us with situations which make us uncertain and sometimes actually afraid. What we worry and complain about are such things as how can we get more recognition, more money, more and better equipment, or a better job. But these are things we can't secure all alone — somebody besides ourselves has to do something about them.

Engineers' Typical Complaints

Here are a few of the typical circumstances that confront us as engineers:

1. It is almost impossible to secure recognition or greater income.
2. The company is not progressive.
3. Progress in my company can be gained only by the "high pressure boys."
4. There's no future because there are too many older men ahead of me.
5. There's no credit for routine work, and I never get the spectacular jobs.
6. The management completely disregards the true importance of the field of engineering I'm in, so that little attention is paid to my work.
7. There's no real money in engineering.
8. Engineering doesn't have enough voice in management decisions affecting engineering.
9. Engineering does the work, but someone else gets the credit.
10. Engineers spend most of their time correcting other people's mistakes.

We could go on for quite a while like this, but those are enough to show you the type of circumstances I'm thinking about.

Analysis of Complaints

The seriousness of a complaint depends upon the attitude we take toward it. Too many times it is the state of mind that defeats us, far more than the situation which prevails. As soon as we allow our attitude toward a complaint to degenerate into a state of chronic grumbling . . . usually referred to as "griping" . . . the more certainly we will be brought to a stop or even start sliding downhill.

The surest evidence that we are disorganized is

Excerpts from a paper presented before SAE Detroit Section on May 19, 1947.

our inability to get our mind free from the complaint long enough to go to work on ways to get around it.

Since most of us can't think about two thoughts at the same time, the more we dwell on the unfairness, and the powerful force of the circumstances, the more difficult we find it to move in any direction. Confidence, which is the surest stimulant to action, gives way to fear. Medical men tell us that prolonged fear actually injects serious poisons into the system. Certainly its ability to magnify and intensify the hazards of any course of action sets in a paralysis which resists the strongest kind of effort. So, when we permit a complaint to get under our skin, we give ourselves

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"Let's concentrate on what engineering we should do on ourselves as individuals to accelerate progress. What can we do to improve our methods of surmounting or getting around human obstacles?"
||

over to a drug that really disorganizes us. It blunts the sharp edge of our initiative, it neutralizes the finest technical proficiency, and it completely disrupts our ability to exercise good judgment.

To make progress as engineers we must become better engineers, of course; but we must also improve our ability to make a constructive approach to the circumstances that bother us. We could learn something from our usual engineering approach to problems involving physical laws. When you stop to think of it, we could have a lot of complaints against nature. Imagine the performance we'd get out of our cars if we could make a few exceptions to the law of gravity. How much easier it would be if nature didn't insist in using up a lot of energy in the form of friction and heat! Think of all the troubles we get into because mechanisms are subject to wear. How it would simplify things if there were no such thing as corrosion or rust! Everywhere we turn we run into circumstances which slow down or limit our progress, or force us to go in some other direction. So what do we do . . . complain about it? Sure we do, but not very seriously, and not for long. Why? . . . because we have come to accept natural law not as a reason for personal complaint, but as a challenge. Instead of losing sleep over it, the engineer has concentrated his time on finding ways either of using the forces of nature or of avoiding harmful conflict with them.

The point of all this is to show how consistently we, as engineers, demonstrate that it's not the size of the obstacle but the constructive approach to its solution that's important.

As far as I can see, the principal difference between the magician and the engineer has been a state of mind . . . a method of approach. The laws of nature haven't changed. The same forces that today can drive a car over two miles a minute have existed since time began. The obstacles that made such performance seem fantastic even 20 years ago are also still there. But we ourselves have seen the tremendous strides made in the field of automotive engineering alone. Present day engineering accomplishments prove that there is no ceiling, no door completely closed, when the attack is made in a constructive state of mind.

The conclusion seems obvious . . . to make the most of engineering, we, as people, should apply the same approach to our complaints against circumstances that we, as engineers, have used so successfully in capitalizing on the obstacles we're continually fighting in natural laws.

It's not easy to take this objective view of personal obstacles, because when people oppose us, the most natural thing is to get upset. We have all kinds of energy to pour into impatience, anger, resentment, suspicion, and injured pride; but it's something else again to force our thoughts into channels of analysis, unprejudiced judgment, enterprise, and constructive action in spite of disturbing circumstances. It takes hard work, without much let up . . . but it's worth trying. If we succeed, it means we will replace bitterness and disappointment with assurance and satisfaction. What's more, when we try it, we discover that our growth and the measure of our success increases whenever we apply reason rather than emotion to every obstacle in our path.

||
"The surest evidence we are disorganized is our inability to get our minds free from a complaint long enough to work on ways to get around it."
||

I don't want to imply that we should never complain - far from it! Unruffled contentment with ourselves and our surroundings may look inviting from a distance. Yet, like a complete balance of forces, it means no movement, no forward progress, no development. Dissatisfaction with circum-

stances, and with our rate of progress, in itself, then is a healthy symptom. More than that, it's the initial spur to personal advancement. For whether it is real or imaginary, larger or smaller than it appears, if the obstacle is used as a starter, not a brake, it can serve as a sure means of driving us to greater efforts, the sure basis of continuous advancement.

Walt Whitman has pointed this out in a famous passage. I have it posted on the inside of my office door as a continual reminder. He asks:

"Have you learned lessons *only* of those who admired you and were tender with you, and stood aside for you?"

"Have you not learned great lessons from those who braced themselves against you, and disputed the passage with you?"

Looking at it from that viewpoint, our various complaints do not diminish in importance, they merely fall into another category. Instead of resenting them as irritating barriers, we recognize them as the potential starting points to substantial progress. Right now, I can practically hear some of you saying: "It would take an electron microscope to uncover any advantage in the present difficulty I'm having in securing either adequate recognition or greater income." Yet, that very kind of difficulty has been an important spur to the growth and eventual progress of quite a few really successful engineers.

To get a better look at exactly what I have in mind, let's set the stage with an automotive engineer . . . any typical member of SAE, who, of course, has been doing a good job. Everything is satisfactory, except one thing . . . the only reward he's had for doing good work is to have more of the same dumped in his lap in stifling quantities. And because nobody has taken him up to the mountain top to show him the new territory that's being turned over to him, he figures the road is permanently blocked and that the only solution is to find a new mountain!

There isn't one of us who, like our typical engineer, doesn't feel perfectly capable of carrying greater responsibilities. We all know that, if we were given the opportunity, we could do more important work than we are doing today. The stronger we feel that way, the more disappointing it is for months or even years to roll by without the company showing any appreciable recognition of our real talent. Like us, this typical engineer we're using for an example can point to an excellent record. He's taken a personal interest in each new project. He's made many contributions beyond the actual requirements of the job. He's given unswerving loyalty to his superiors and the management. He knows he is the type of person who should be a key man in the organization.

The company, while recognizing the value of these qualities, looks at each one of us from its own perspective, and through eyes which are look-

ing for other qualifications as well. It must think in terms of group objectives, of broad purposes to

The Author



James C. Zeder

be attained, and of progress through team work, and organization. There are various types of work to be done, but as a company grows in size, the more necessary it becomes that people fit themselves to jobs rather than that jobs be created to fit people.

While our typical engineer may be using a foot rule to mark off the extent of his abilities, the company may have to employ a yardstick. Our fitness to be given work of broader scope depends upon qualifications beyond the satisfactory performance of our present jobs. It isn't simply a matter of how far we personally have advanced during the past years. The deciding factor is how close we have managed to come to the ideal requirements for the particular position which needs to be filled.

In this connection, how often do we stop to consider the ways in which we ourselves are being "typed" by our associates. We do that very thing, almost automatically, to those around us.

At the same time we are being catalogued . . . but under what headings, do you suppose? If we could only look at ourselves from the viewpoint of those who do the selecting for each new job, what do you expect we'd see? Are we "too cool and aloof to work with others" . . . do others feel we're "too opinionated and know all the answers" . . . are we "impatient and short-tempered" . . . are we continually being "misunderstood"? How do we really stack up as building material? Do we fit in with the rest of the structure? Are we fully prepared to carry our full share of the load? After a glimpse like that, I think every one of us would recognize that there should be a few changes made . . . in US.

Proficiency Not Enough

The more you study individual cases of engineers whose progress has lagged seriously behind their engineering ability, one thing becomes in-

creasingly evident . . . Technical proficiency, alone, is not enough. In fact, too much emphasis on scientific achievement can, itself, be one of the very reasons why some engineers continue to be passed by. In concentrating on engineering, these men may have completely neglected to consider or develop those other characteristics which carry men ahead. Unfortunately, as more and more interest is centered on engineering problems alone, the ability to find and make use of new avenues of personal development and progress seems to diminish.

As engineers, we have many fine prerequisites to success. The difficulty with many of us is that we're not prepared to make the best possible use of our equipment. Any of you who are fishermen and who have really whipped a stream know that there's a lot more to fly fishing than having just the right weight of rod, the most modern type reel, the finest, smoothest running line that's available, and the latest versions of the flymaker's art. For, even though the stream is well stocked, you can catch more frustration than fish if you don't cast in the right pools, drop the fly down in just the right way, and work with the sun, wind, and stream, rather than against them. Good equipment helps, but it's how you use it that really fills up the creel.

So, just because you haven't caught any good-sized fish in the engineering stream you're working, don't blame the stream, or necessarily the equipment, which in this case is your own engineering training and experience. Instead, the chances are that it's the way you're using it that's at fault.

To get back to our hypothetical engineer, what is it that he should do if he is to make the most

||
"To make the most of engineering we should apply to our complaints the same approach that we, as engineers, have used so successfully in capitalizing on the obstacles we are continually fighting in natural laws."
||

of himself and of his engineering. No two people can use an *identical* plan because each of us is different, in background, in personality, and in our own interpretation of what constitutes a satisfactory objective.

Yet, in any company, there are certain methods of approach, particular abilities or ways of doing things, which secure more favorable attention than others. Again, there are common denominators of personal advancement that have proved to be effective in one company after another.

Extensive studies have already been made with which we can supplement our own findings.

One group of investigators, for instance, learned that the most widespread and useful characteristic of success is the ability to get along with people. That doesn't mean being an easy mark . . . letting others run over you.

To get places, you must get things done. But some individuals seem to do that with an unusual amount of cooperation from others, and a minimum of opposition. In fact, that's how they manage to out-produce the rest of us by enough margin to secure the kind of recognition we'd like to get. Yet, along the way they make many real friends and few actual enemies.

We all can think of individual engineers who are brilliant men, but who have found themselves stopped time and time again because of failures in getting along with people. They are men of keen vision and truly advanced ideas, but they're always looking in vain for a congenial atmosphere. No matter where they go, things are never quite right for *them*. They are full of zeal, imagination, and initiative . . . all prerequisites of success. The trouble is they have applied these talents to only one-half of the job . . . the technical side. As a result they are continually in trouble because of the lofty, uncompromising attitude they feel they must take toward others. Quite unintentionally, they set up a corrosive action which undermines the best efforts of those around them with an atmosphere of antagonism. They honestly can't understand what causes the trouble. Eventually, they become convinced that everyone is lined up against them.

Other engineers seem to develop what might be called the porcupine approach. They always know all the answers. So, whenever any outside suggestion is made, they invariably have a well-sharpened quill ready to puncture the would-be cooperator.

Then, there are those of us who tend to feel that compromise is just as unthinkable in actions or methods of operation as it would be in technical opinions. So we find ourselves inflexibly anchored to one spot.

In addition, there's the super-scientist who always seems to be misunderstood. He is, quite literally, in fact, simply because he never feels it worth while to put aside enough of his advanced technical terms to be understood by those outside his own highly specialized field.

But, most important of all, there are a lot of us, like you and me, who aren't prima-donnas, but who

still don't travel at anywhere near our potential rate. Like the others, we owe much of our own trouble to our failure to pay as much attention as we should to the important matter of human relations.

A second characteristic of successful people is their habit of looking beyond their own department, or their own activity . . . and the object is seldom to locate greener pastures. Instead, they are continually searching for ways in which they can make their own efforts contribute more to the rest of the organization. That's not altruism . . . far from it. They've discovered that their own market value goes up whenever they extend their services. Greater recognition is theirs as fast as more people understand the use and importance of what they're doing.

A third avenue to progress is traveled by the people who are consistently moving up, entirely independently of company plans and any regular promotion schedule. Instead, they exercise considerable control of the time, rate, and direction of their progress by doing a great deal of planning of their own.

In their efforts to move ahead, they work as untiringly and in as many directions on personal development as any engineer worth his salt expects to work on getting the bugs out of a new process or an experimental model. If one plan fails, they pick up the pieces, determine the probable cause of failure, and then put together another one. The next one should do better, because it avoids the pitfalls that apparently wrecked its predecessors.

Right here I'd like to emphasize one thought as strongly as I possibly can. It's this:

Personal progress, if it is to be lasting, must be based not on smart moves or clever scheming, but on the strengthening of fundamental qualities. The self development must start from the core of the individual. A quick case-hardening of the surface won't take the load . . . the base material itself must be improved.

Every outstanding leader, the sort of man you and I recognize as a "topper," gives us the finest proof of much that we've been discussing. His sincerity and genuineness are inescapable. He's not putting on an act—he's being himself. And the edge he has on the rest of us, above everything else, is the successful attitude, or state of mind we've talked about.

Each of us has seen this kind of person in action at one time or another. Time and again he amazes us by pointing out many ways to improve something we thought was the last word! He begins where we are ready to stop. I've seen this happen in such widely different circumstances as designing a new model, planning a new engineering program, appraising a new mechanism, or working out the basic lines of an entirely new activity. The amazing thing is that his suggestions seem to come readily, and are sound, no matter what the

subject. His is an orderly, well-trained mind to which he adds an exceptional ability to see things in their right light and true perspective. With this combination, he can find the road through or around a difficult situation with few, if any, false starts, and with a minimum of wasted effort. His energy is concentrated on going beyond it.

He isn't blind to obstacles—far from it. As a matter of fact, he sees them more clearly than

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"Just because you haven't caught any good-sized fish in the engineering stream you are working, don't blame the stream, or your own engineering training and experience. . . . Chances are that it's the way you are using them that's at fault."
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most of us, because his vision isn't cluttered up with worry over their existence. He knows there are always ways around even the most disturbing circumstances, so he looks past them. His mind is free from confusion. He moves without lost motion. His decisions are quick and clear. He leads because he's always thinking ahead of us.

Are men like these in a class set entirely apart, which we can but admire from afar? Are these men endowed with so much more talent than the rest of us? Are they gifted with aptitudes beyond our reach? Probably in some cases they are . . . but I honestly don't believe many of them are much different from you and me . . . except in one all-important particular. That's the matter of attitude . . . the state of mind with which they bring success to everything they do.

Conclusion

Going back for just a minute to those 10 complaints we listed at the start, we can look at them either individually or as a group. In any case, we can agree that they all are vulnerable to trained attack. And to my knowledge there is no profession better equipped to make that kind of attack than ours.

Each one of us can make more progress in engineering if we are willing to carry on a serious program of self-development and self-adjustment. By so doing, we will gain the stature and maintain the attitude which will give us capacity for progress beyond whatever problems we meet.

Modern Technology Holds Key to

BASED ON A PAPER* BY

EDMUND B. NEIL

CONSULTING ENGINEER

(This paper will be published in full in SAE Quarterly Transactions)

BLENDING today's knowledge of thermodynamics, materials, and automotive design principles with further research can produce a successful vapor¹ powerplant by eliminating those disadvantages that forced abandonment of steam-powered cars years ago.

With the tremendous strides made in engineering know-how since that time, possibilities of vapor-powered vehicles merit real consideration. This is particularly true in the light of the following advantages – from a motor vehicle standpoint – inherent in reciprocating vapor engines:

1. Their torque and power characteristics are suited to vehicle requirements. The wide variation in mep makes for high stall and starting torque and self-starting at full torque, in either direction of rotation.

2. Separation of compression and expansion functions allows – theoretically, at least – expansion ratios far higher than in any internal combustion engine. Theoretical ratios in a reciprocating vapor engine may reach 80 or 100 to 1. In practice, automotive-size vapor engine cylinders can probably exceed 25 to 1.

3. Higher initial and average pressures and the two-stroke cycle action of this engine offer higher output per cubic inch displacement. Engine weight can be lower because vapor powerplants need only one-half to one-third the displacement of equivalent internal combustion engines.

¹ Since the thermodynamics in the paper on which the article is based applies to most vapors as well as to water vapor (steam), the general term "vapor" is used.

* Paper "Thermodynamics of Vapor Powerplants for Motor Vehicles," was presented at SAE Summer Meeting, French Lick, Ind., June 3, 1947.

4. Engine efficiency should be higher than that of equal-output internal combustion engines under most operating conditions.

5. Fewer operating parts should make the vapor engine simpler and less costly than its internal combustion counterpart. Elimination of units such as the clutch and transmission and simplification of fuel ignition and carburetion are but a few potentialities.

Additionally, the engine operates with virtual silence; makes waste heat available for occupants' warmth; minimizes vibration problems; gives smooth, constant-rate acceleration; and is infallible in cold-weather starting.

These advantages become all the more attractive as the possibilities of hurdling often-mentioned vapor engine obstacles approach realization.

For example, it is true that changes of state of the fluid – such as transition from vapor to liquid – introduce heat losses. This may be largely reduced in a regenerative system. Regeneration should also reduce required condenser size and capacity and improve efficiency at normal loads.

A method of obtaining the regenerative cycle is shown in Fig. 1.

Another steam engine headache that no longer need be tolerated is frequent replenishment of fluid. Thermodynamically, there is no reason why this should be necessary any more than in a refrigeration system.

Modified to have better antifreezing quality and possibly slightly lower vapor pressure, water is the most suitable fluid presently known for an automotive powerplant.

Glycols and alcohols now commercially available at low cost seem to have the necessary properties both to lower freezing temperatures and to modify water vapor's pressure-temperature relationship along desired lines. Thus, freezing of fluid in cold

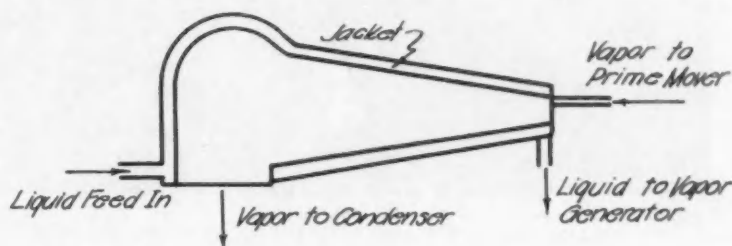
to Vehicle Vapor Powerplant

Fig. 1—As shown in the top view, the regenerative cycle might be obtained by surrounding the vapor turbine casing with a fluid jacket. The condensed liquid under vapor-generator pressure enters the jacket at the low-pressure end, passes along the length of the turbine to the high-pressure end, and leaves the casing at the same temperature of the high-pressure vapor entering the turbine.

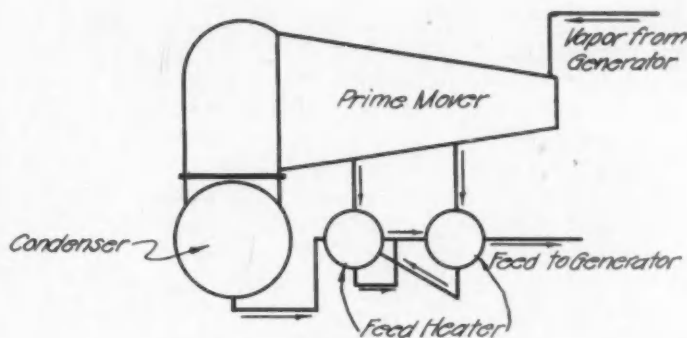
The liquid then requires only the addition of the heat of evaporation to again be ready for expansion.

But with such method, the quality of vapor leaving the turbine is likely to be low enough to seriously erode the blades. And a jacket under vapor-generator pressure would need thick metal sections and would introduce other design problems.

"Bleeding" small quantities of vapor from the turbine casing at various points to heat the liquid in a series of stages, as in the bottom view, is more feasible. At each extraction point the vapor combines in an open heater with the liquid and is pushed on to the next stage by a series of separate feed pumps. This bleeding operation prevents the end quality of vapor in the turbine from falling below safe blade-erosion limits



Theoretical Method of Regeneration



Practical Extraction Method of Regeneration

weather need not pose a serious problem.

Low fuel efficiency of vapor engines is a very legitimate objection; but it applies only under certain conditions. Reduction of economy losses due to low expansion ratios is possible, although further study of methods to achieve this appear necessary.

If maximum economy with low-cost fuel or prolonged operation of a heavy vehicle at or near maximum power output is essential, a single "emergency" gear reduction will permit development of desired horsepower at higher engine speeds. This will increase expansion ratio and engine efficiency. It

also will reduce overall powerplant weight for such applications.

Start-up time ranging up to 15 min plagued steam car operators in the "Steam Is Supreme" days. But that's because none of the early vehicles, except two, used current methods of burning liquid fuels. The cold-start warm-up period can undoubtedly be reduced to less than 1 min by using a water-tube type of generator and modern burner equipment—the kind used in aircraft and bus heaters.

With such equipment, heat transfer rates and heat liberation rates from the fuel far higher than

concluded on page 36

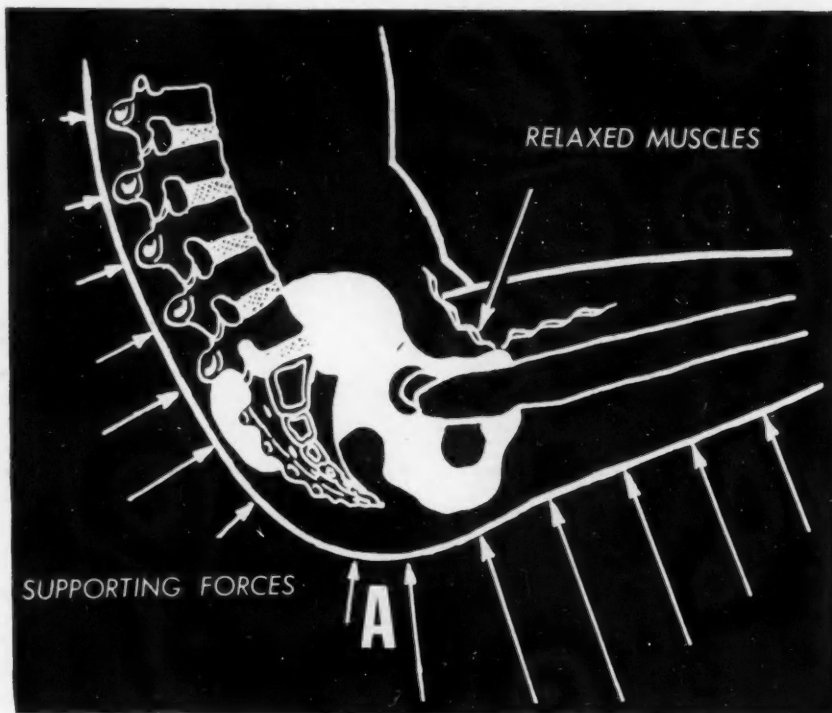


Fig. 1—Body seated in relaxed position. Length of arrows indicates relative magnitude of supporting forces needed

PEOPLE have been building and sitting in chairs for thousands of years, but it is only recently that anyone thought of using a scientific approach to chair design. Now one new adjustable type of aircraft seat has been designed to be comfortable for almost every passenger—designed from an elementary knowledge of anatomy plus data on anatomical variations among the riding public.

From an engineering point of view, the body structure consists of tension members, compression members, and levers. The tension members position the compression members and actuate the levers. Loads imposed upon any of the tension members for a period longer than normal endurance result in strain. The nervous system indicates strain by the unpleasant sensation which eventually becomes pain.

Fig. 1 shows the body seated in a relaxed position. If we imagine the body seated this way in a straight-backed chair, we can see that the region of principal support will come between the two arrows at A. The weight of the upper body, transmitted along the spine to its end, acts considerably to the rear of the supporting force. The result is a couple which must be resisted by the back muscles attached to the lever-like extensions from the vertebrae.

Strain in these back muscles can be prevented

by shaping the chair to support the lower back. In a good design, the supporting forces will be distributed along the body about as the arrows indicate. Support behind the lateral wings of the pelvis (represented by the upper part of the white mass in Fig. 1) will eliminate the principal rotative tendency of the pelvis and greatly reduce the stabilizing support needed along the upper back.

Erect Sitting

But the passenger doesn't always sit back relaxed. Sometimes he assumes a more erect position for eating or writing. Then his body needs support at other spots.

The erect sitting position is accomplished by contraction of the back muscles. The contractive force must be adequate to rotate the pelvis forward and stretch the stomach muscles simultaneously, as shown in Fig. 2. This activation of the back muscles causes the fatigue we feel after sitting erect for a long time.

The rotation of the pelvis gives a higher elevation to the lowest group of vertebrae. The body weight rests on the ischial tuberosities (two bones, one on either side, extending downward under the pelvis). These are the bones which must be supported for erect sitting as the heavy arrow in Fig. 2 shows.

* Paper "Passenger Seats Can Be Comfortable," was presented at SAE National Aeronautic Meeting (Spring) on April 10, 1947.

and STATISTICS AID DESIGN of Passenger Seats

FROM A PAPER* BY

Charles W. Morris

Sales Engineer, Doak Aircraft Co., Inc.

The size and shape of chair which will provide real comfort for the majority of people riding the airlines depends on their variations in stature and body conformation. People vary so much that chair design, like design of so many other items, must always be a compromise. The data on anatomical variations gathered by Hooton¹ are quite valuable for determining the best compromise.

Hooton's statistics show that 80% of all men and 85% of all women are between 62 and 72 in. tall. This appears to be a good range of heights to design to.

By preparing body posterior contours from reliable data for short and tall figures and aligning them on common seat and back contours, it is possible to see what variations in leg length and head height must be accommodated.

A seat height of about 17 in. appears to be good for the range of leg lengths.

The contours show that the head rest cannot be made to furnish support at the base of the skull for the short person, as one authority proposes, without being too low for the tall person. They will give an idea of the vertical length of the pillow which will support the range of head heights comfortably.

A pillow having a shape somewhat concave when viewed from above will provide enough lateral sup-

port for the head when the passenger is asleep. The concave pillow is preferred to wings because it does not impede lateral vision or conversation with the person in the adjacent seat - and surveys show that the passenger likes to be able to talk

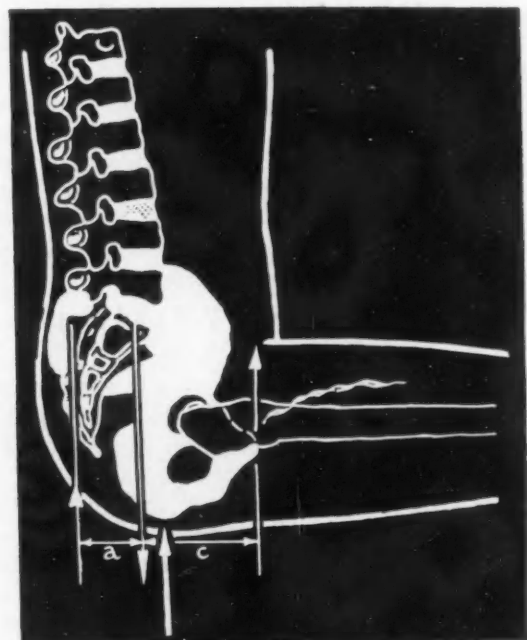


Fig. 2 - Body seated in erect position. Light arrows indicate forces required of back muscles to balance stomach muscles. Heavy arrow indicates supporting force needed

*See "Survey in Seating," by Earnest A. Hooton. Published by Heywood-Wakefield Co., New York City, June, 1945.



Fig. 3 - Outline of passenger seat designed from anatomical data. Both relaxed and erect positions shown

with his seatmate. Wings do afford a little privacy, but it's the kind the proverbial ostrich gets when he sticks his head in the sand.

The point to be remembered in the design of back rests is that at any point the cushion's ability to support depends on its deflection. The supporting pressure of the chair should be greatest toward the lower spine, reaching a maximum behind the pelvis, to offset the couple imposed on the pelvis when the passenger is seated in a relaxed position.

Too many back rests are designed like over-stuffed chairs with a convex vertical contour. The human back also has a convex vertical contour, so that when the back and the back rest come together the greatest deflection and support often come at the waist instead of where support is needed.

With the pelvis properly supported, there is no need to slide the buttocks forward from the back of the chair. The chair seat length from back to front can be shorter.

Seat Has V-Shaped Edge

According to Hooton's statistics, a seat cushion length of 17.5 in. is short enough for all but 6% of the men and 20% of the women sitting in the erect position. A cushion 3 in. longer is long enough to give adequate support under the knees for all but 7% of the men and 2% of the women.

One seat has been designed for the comfort of the 87% of the men and the 78% of the women, who require seats from 17.5 to 20.5 in. long. The seat has a V-shaped front edge so that the seat length is shorter at the center than it is at the sides. This has been found comfortable for women, who tend to be shorter-legged and who like to sit with knees together or crossed. It's comfortable

for long-legged men, too, because they generally prefer to sit with knees spread to the sides of the seat.

The basic width required for the seat is dependent on overall hip breadth. Hooton's survey shows a variation from 12.0 to 21.3 in. Men averaged 15.3 in., and women - although they are generally considered to be broader hipped - averaged 14.6 in. Over 95% of all men and women measured were less than 17.5 in. wide at the hips. Seats 19-in. wide will accommodate 99% of all potential passengers. Seats an inch or two wider will increase comfort by giving a little more room for shifting.

Seat Bottom Moves with Back

When the back rest is moved to the reclining position, the seat bottom must move also to prevent the passenger from sliding down and out of his chair. Lack of this complementary motion was the chief fault of the old-fashioned Morris chair. In the rocking chair, the angular motion of the seat is as great as the motion of the back because the two are one unit. But, short-legged people cannot tip back very far in a rocker because their legs do not reach the floor from the rising front edge of the seat.

What is needed is some tilting of the seat without change in height of the front edge. The problem can be solved by pivoting the seat at the front edge and linking the seat and back rest together in a suitable manner. A seat tilt of 12 or 14 deg from the horizontal will compensate for a back-rest tilt of 40 deg from the vertical.

It is a good idea to arrange the linkage so that the seat and back lengths remain constant throughout the motion. This eliminates the tendency that some adjustable chairs have to pull out shirt tails and hike up dresses.

The AAF's Aeromedical Laboratory has observed that the shoulders and elbows lower about 1 1/4 in. in going from the erect to the relaxed position. Movable arm rests will compensate for this elbow movement and overcome the complaints of passengers that their elbows "go to sleep" when the seat is reclining.

Fig. 3 shows the outline of a seat design based on all these considerations.

In going from the reclining to the erect position, the passenger does not simply pivot about his center of gravity; his center of gravity must be raised. The means used to elevate him should require a minimum of effort on his part, yet be self-contained and require no external source of power. All this has been accomplished by means of a simple hydraulic actuator operating in conjunction with an air chamber. The erecting force furnished by the air pressure is conveniently controlled by simple valving of the oil entering or leaving the hydraulic cylinder.

SAE NOMINEES FOR 1948

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THE following men were elected to serve on the Council for 1947-48: **MARCUS L. BROWN, JR.**, President and Factory Manager, Seiberling Rubber Co. of Canada, Ltd.; **ELMER McCORMICK**, Chief Engineer, John Deere Tractor Co.; **CHARLES H. MILLER**, Export Service Manager, White Motor Co. Serving on the 1948 Council as Past-Presidents will be **C. E. FRUDDEN**, Consulting Engineer, Tractor Division, Allis-Chalmers Mfg. Co.; and **L. RAY BUCKENDALE**, Vice-President, in Charge of Engineering, Timken-Detroit Axle Co.

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A FUEL injection engine with spark ignition has been designed to give reliable operation even at low speeds.

This engine, like the diesel, gives a part-load fuel economy superior to that of the carburetor engine for it operates with the air intake wide open at all loads. It has, moreover, several advantages over the diesel engine: easier starting, greater speed range, lighter weight, adaptability to small sizes, and insensitivity to different fuels.

Satisfactory results have been obtained with these engines in both automobiles and tractors. Valves, cylinder walls, pistons, and piston rings appear to be better off than those in a gasoline engine. The engine has been free from erratic or unreliable operation requiring readjustments, for its performance is built into it rather than being adjusted into it.

Description

Fig. 1 shows a cross-section of the engine, which was built from standard, production gasoline engine cylinder blocks, pistons, and bearings, as apparently there is no need for anything more durable. Start is effected by a 6-v starter or a hand crank. When cold a prime of gasoline is necessary, but no warming up is required, as the engine runs steadily as soon as it starts, regardless of temperature.

Various fuels have been tested with surprisingly similar results. Knock rating, ignition rating, and volatility do not seem to make much difference.

* "Paper Fuel Injection with Spark Ignition" was presented at the SAE Summer Meeting, French Lick, Ind., June 6, 1947.

Fuel Injection With Spark

If the engine were more highly developed, however, it would probably do best with fuels having a moderate octane rating.

Operation

The intake and exhaust valves are seated with their heads flush with the lower face of the cylinder head, and the flat top of the piston comes close to the cylinder head, so that the cone-shaped

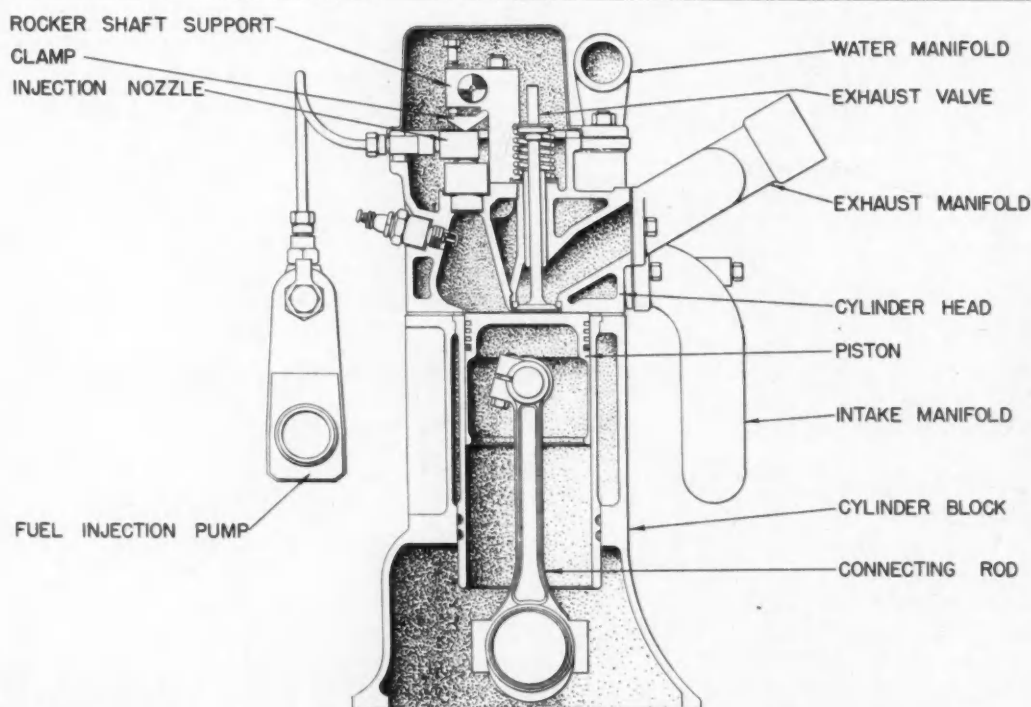


Fig. 1 - Cross-section of engine.

Compression ratio can be 7 to 10:1

Injection starts at 40 deg BTDC for full-load, is retarded for part-load operation

Injection terminates at 20 deg BTDC

Spark occurs at 20 deg BTDC

Engine Ignition

BASED ON A PAPER* BY

ALLAN M. STARR

Consulting Engineer, Starr & Sweetland

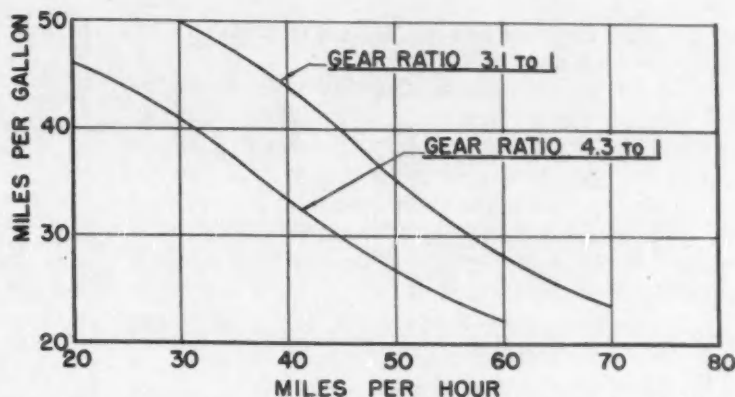


Fig. 3 - Fuel mileage curve (test run on level road) - car weight 3400 lb; 0.855 specific gravity fuel oil; 4-cyl, 200 cu in. engine with 7.5:1 compression ratio

combustion chamber comprises substantially all of the compression space.

The sequence of events is as follows: As the piston is going down, the intake valve opens to let air directly into the cylinder space. The combustion chamber is still filled with the hot residual gases from the previous cycle. As the piston goes up, it compresses the air into the lower part of the combustion chamber, so that the hot residual gases are compressed toward the upper end of the combustion chamber, directly in front of the fuel nozzle.

The opening between the combustion chamber and the cylinder is so large that there isn't much turbulence in the chamber while the air is being compressed into it.

Just before the end of the compression stroke, fuel is injected through the hot residual gases in the upper end of the chamber. Although there

isn't much turbulence, enough of the fuel gasifies and mixes with air in the vicinity of the spark points (even at light loads) so that when the spark occurs combustion starts. By this time the piston is at the top of its stroke, with its flat top squeezed close to the lower face of the cylinder head, setting up considerable turbulence in the combustion chamber. This turbulence intermixes the contents of the chamber so that complete and efficient combustion occurs.

An important feature to note is that the turbulence increases after ignition has occurred. It has been found that ignition is quite unreliable at part loads in a combustion chamber having considerable turbulence at the time ignition is supposed to occur. Full-power output, on the other hand, can be obtained only from a combustion chamber having sufficient turbulence. It is necessary, therefore, to time the turbulence so that it does not interfere with ignition, but so that it does cause complete combustion after ignition has occurred.

When operating at full load, detonation will occur if the spark is retarded from the normal setting, just as a diesel will run rough if it has too much ignition delay. At the normal setting most of the fuel charge is injected before ignition occurs, but apparently there must be a time interval, after injection terminates, for a homogeneous, detonable mixture to develop in this engine. Hence, its detonation control depends on the time interval during which the fuel drops gasify and intermix with the air.

Part-Load Operation

The greatest difficulty in developing the engine was to obtain reliable ignition throughout all loads and speeds of operation. This difficulty arose because a spark can ignite a gaseous air and fuel mixture only with a ratio between certain rich and lean limits.

Satisfactory ignition was finally obtained at light loads with the help of a novel arrangement, which cuts out one-half the cylinders as the load drops below 25%, allowing the remaining cylinders to work hard enough to keep the spark plugs clean

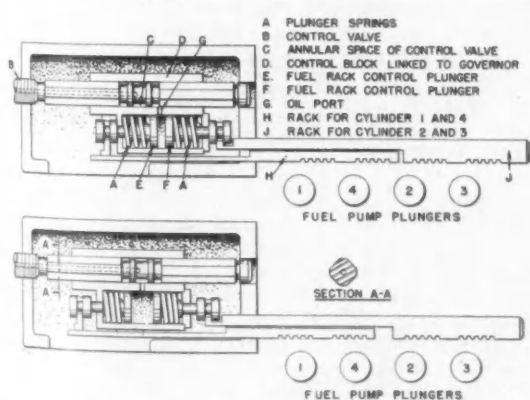


Fig. 2 - Split fuel rack

and to burn the fuel charge before it is lost in too much excess air.

Fig. 2 shows this mechanism for a 4-cyl engine. The slit fuel pump rack *H* and *J* regulates the fuel metered by the pump in a well-known manner. Lubricating oil pressure from the engine is used to actuate the racks at the proper moment, so that only two of the cylinders are operated. Engine oil pressure is always available in the annular space *C* through the control valve *B*.

The governor or throttle control is linked to the block *D*, so that the latter moves in response to the load the engine must carry.

The upper view of Fig. 2 shows the position when operating above one-quarter load (all four cylinders in operation). Port *G* is located to the right of the annular space *C* and the springs *A* are holding the pistons *E* and *F* as near together as they can go.

The lower view shows the position when operating at less than one-quarter load. Only cylinders 2 and 3 are in operation. Block *D* has moved to the left so that port *G* is supplied with oil pressure from space *C*, forcing pistons *E* and *F* as far apart as they can go. The motion of piston *E* moves the fuel pump rack *H* so that cylinders 1 and 4 are shut off. The motion of piston *F* moves rack *J* so that cylinders 2 and 3 receive additional fuel to carry the load dropped by cylinders 1 and 4. Moving the block *D* always moves both halves of the fuel rack together, whether they are in the relative position shown in the upper view or that of the lower view. Thus the output is controlled, whether the engine is operating on two or on four cylinders.

In other words, as the engine changes from 25% to 24% of full load, the fuel to half the cylinders cuts off and, at the same time, the fuel to the other half increases so they carry the load without any speed drop. Likewise, if the load changes from 24% to 25% of full load, the dead cylinders begin to fire and the other cylinders receive less fuel, thus avoiding an increase in speed. With this system, a flyball governor can be linked to the fuel metering pump and give stable control throughout the load and speed range. To avoid any tendency to hunt between the two and four cylinders when operating with a governor, it is necessary to adjust the cutout mechanism so it overcontrols a bit. For example, when the load is decreasing and half the cylinders cut out, then the cylinders that remain working receive a little more fuel than is necessary to carry the load at the instant the changeover occurs. As a result, the governor moves away from the changeover point and hunting is prevented. In actual operation this control is smooth and the change from two to four cylinders would be hard to detect if it were not for the change in exhaust noise.

Fig. 3 shows the part-load economy of this engine obtained by running the car in both directions and averaging the results.

Gives Limitations of Injection Engines

Based on a discussion by

ARTHUR W. POPE, JR.

Waukesha Engine Co.

If injection engines are to justify their existence, they must have a higher thermal efficiency than gasoline engines, because the cost differential between light and heavy fuels is rapidly disappearing.

The combustion efficiency of the Starr engine is as high as that of any spark-ignition engine ever tested by the author, but it still has fundamental combustion limitations. To obtain efficient utilization of the air, fuel must be vaporized and mixed with all the air in the cylinder before combustion is completed. Engines that inject the fuel near the end of the compression stroke allow so little time for atomization, vaporization, and mixing that these operations cannot be completely accomplished soon enough to provide full combustion efficiently, especially at high speeds. This limitation applies to both diesel and spark-ignited injection engines.

If the performance of a carburetor engine is compared with that of the Starr, both using low-octane fuel of the same rating, the Starr engine will give the higher economy, but if the engines are compared when operating at the same compression ratio, the carburetor engine using a high-octane fuel so as to operate without detonation, the carburetor engine will show the better efficiency. The diesel gives the best efficiency only because it is able to operate at extremely high compression ratios, as shown in Table A.

Table A - Comparison of Various Types of Engines

	Fuel		Compression Ratio	Economy	Bmes
	Octane	Cetane			
Starr -					
3 3/4-in. bore....	30	45	7.5	0.53	97
Carburetor	85	..	7.5	0.51	128
Carburetor, h o t					
manifold	30	..	4.2	0.65	90
Diesel	30	45	17	0.48	107

The trend toward more compression-ignition diesel engines is a sound one, as it is based on the principle of more efficient fuel utilization. There are limited applications, however, where factors other than combustion efficiency control the overall cost and suitability of an engine. Here there appears to be a market for the spark-ignited injection engine operating on diesel fuel. It is quite apparent, however, that developments in the diesel field are rapidly overcoming the mechanical limitations of the diesel engine, and the field for the spark-ignition injection engine is shrinking in proportion.

The effect of supercharging has not been considered here because it is too complicated to discuss in a few words, but it must be remembered that supercharging reduces the efficiency of engine types whose compression ratio is limited by fuel detonation considerations and improves the efficiency of engines not limited by detonation. This opens a wide field for the development of the injection engine, but leaves the carburetor type almost entirely dependent upon fuel developments for its progress.

The British Outlook on FUTURE AVIATION ENGINES

Rod Banks, former Air Commodore, RAF, and Director of Engine Development, Ministry of Aircraft Production, here lays down Britain's present program for gas turbine development.

Augmenting Banks's technical discussion of gas turbine features is an exposition of the philosophy he believes manufacturers

and governments must follow to maintain a forward aviation policy, in the interests of national defense.

Discussion at the meeting at which Banks presented his talk indicated that his opinions and concepts regarding gas turbine development parallel closely the thinking in this country.

AS SEEN BY* **F. R. BANKS** Technical Manager & Chief Engineer, Associated Ethyl Co., Ltd., London

TURBOJET and turboprop engines will power all coming British aircraft, relegating the piston engine to obsolescent military and interim commercial airplanes. But continued gas turbine development—which is beginning to clarify the merit of such features as compressor types, ducted fans, regeneration, turbine efficiency, and compression ratio—must be maintained if air progress is to keep stepping forward.

Reciprocating engines have no place in plans for British commercial and military machines, except for small feeder liners. But since it will be at least five years before prototype turbine-engine airplanes are ready to fly the air routes and several more years to gain experience with this new class of aircraft, present types will serve for about 10 years.

The piston engine is no competitor of the turboprop since coming military and commercial airplanes will travel at high speeds and require large powers. And while larger up-and-down engines can be built, it is not considered worth the time and effort. Additionally, the tremendous built-in drag of a piston engine installation comparable in power

output to a turboprop would more than nullify the piston engine's economy in specific fuel consumption.

And the turboprop will probably attain the equivalent of the very large piston engine fuel consumptions at cruising condition—this condition is a high percentage of its full power.

Compounding, to boost present type gasoline engines for power or to improve their fuel economy, has been ruled out. Operating ranges of present commercial aircraft do not justify the added complication, cost, and detraction of effort from gas turbine development.

The British are not gearing back exhaust turbines to reciprocating engines for another reason. They had no ready means of compounding their engines as did the Americans, who could use their turbos which were developed for exhaust turbosuperchargers in military aircraft.

I do not foresee longer ranges than 3000 miles (4000 miles still-air) for aircraft fitted with the jet turbine and I believe that the propeller turbine would be used for the longer range aircraft. Propeller turbines presently under development in England will be used in moderate-range and moderate-altitude aircraft, cruising at about 300 mph. An exception is the Bristol Brabazon I, which was in-

* From an extemporaneous talk, "The Outlook in Aircraft Propulsion," presented at SAE Metropolitan Section, New York, June 23, 1947.

Current

FIG. 1

3-2-1-2-3 GAS TURBINE (TWO STAGES)

T-10 STAGE TURBINE AND COMBUSTOR

REAL FLOW GAS COMPRESSION: A BELLER

GUSTY SECTION

FRONT MOTOR MOUNT

COMBUSTION ROCKET (CAND)

TURBINE BASED OUT THE EXHAUST TUBE

COMBUSTION AIR

J. H. H. 1950

Bristol Theseus I

THE turbojets and turboprops shown here are examples of recent gas turbine configurations developed by the British.

Using an axial flow and centrifugal compressor in series, the BRISTOL THESEUS is said to gain theoretical advantages. The centrifugal compressor assists the axial compressor over its relatively narrow operating range, particularly during engine starting. This eliminates instability and promotes operational flexibility.

But more experience must be gained with this arrangement before its theoretical advantages can be proved.

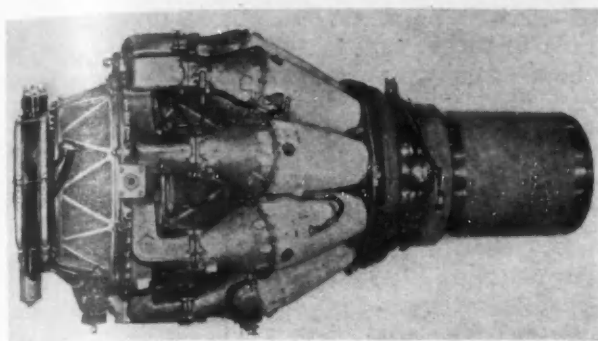
A two-stage turbine drives both the axial and centrifugal compressors. Another turbine wheel, fitted to a shaft which passes through the hollow shaft of the two-stage turbine and compressors, independently drives the propeller through double reduction gearing.

This mechanical separation of propeller turbine from the compressor is hoped to give added flexibility, as in overspeeding the propeller for take-off. If realized, this will also enable the pilot to use a lower propeller speed for landing and taxiing. Separating the propeller from the compressors is also helpful in reducing starting power requirements since no power is absorbed in turning the propeller.

Armstrong Siddeley Python

turn to page 34

British Gas Turbines



Rolls-Royce Nene I

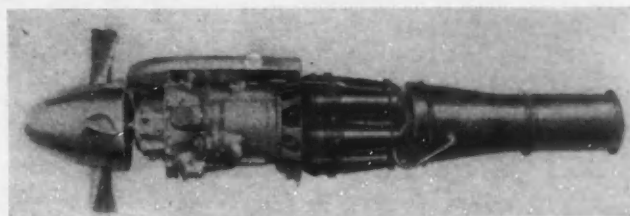
The Theseus has a heat exchanger to improve fuel economy. Some 10% reduction in specific fuel consumption is expected at small expense in power, but with appreciable increase in weight.

Overall pressure ratio of the compressors (axial and centrifugal) is 4.35 to 1. The Theseus develops 1950 shaft hp with 500 lb static jet thrust. The engine weighs 2500 lb without the propeller and its maximum speed is 9000 rpm.

The ARMSTRONG SIDDELEY PYTHON is also a turboprop, but it has an axial flow compressor coupled directly to a two-stage turbine. The propeller is driven through a double reduction gear with an 8.13 to 1 ratio.

This engine has a 54.5-in. maximum diameter and is 85 in. long. Pressure ratio of the compressor is 5 to 1. The Python delivers 3600 shaft hp plus 1150 lb static jet thrust. It weighs 3140 lb without the propeller and has an 8000-rpm operating speed.

Surpassing specifications laid down for its design by the British Ministry of Aircraft Production, the ROLLS-ROYCE NENE I—a turbojet—develops 5000 lb thrust and weighs 1550 lb. Within five and one-



Armstrong Siddeley Mamba

half months, the design was completed, all drawings were prepared, the first unit was built, and a 1-hr proving run at 5000 lb thrust was passed.

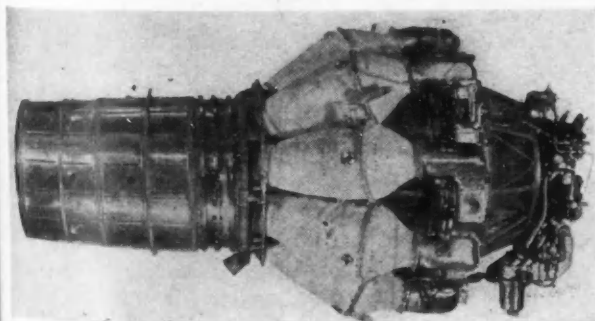
Its double-sided impeller for the compressor provides two air inlets. This cuts down impeller diameter and makes for a smaller package.

A scaled-down version of the Nene, the ROLLS-ROYCE DERWENT V was developed because of the promise shown by the Nene. It delivers a maximum static thrust of 4200 lb for its weight of about 1250 lb.

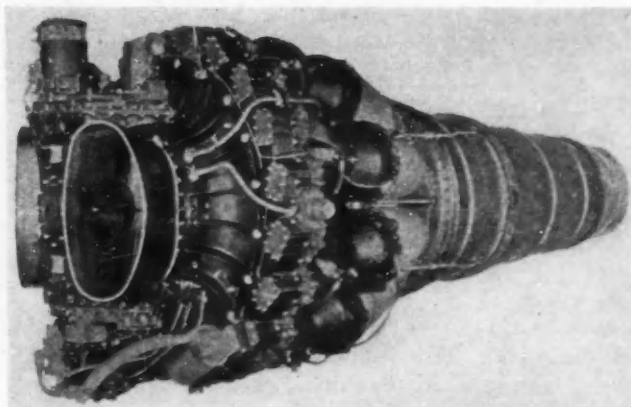
An earlier model, the Derwent I Mark I, now operates 270 hr between overhauls and this time is soon to be extended to 360 hr. Its flame tubes are inspected every 180 hr.

ARMSTRONG SIDDELEY'S MAMBA is an axial flow type turboprop said to be suitable for transport service. It develops 1000 shaft hp and 320 lb jet thrust. It turns up to 14,500 rpm. The engine weighs 750 lb and has a 27-in. maximum diameter.

Another Whittle-type turbojet, the DE HAVILLAND GHOST, produces 5000 lb static thrust for its 2011 lb dry weight. Its maximum speed is 10,000 rpm. The engine measures 53 in. at the maximum diameter and 122 in. in length.



Rolls-Royce Derwent V



De Havilland Ghost

given diameter and can go to higher pressure ratios with high adiabatic efficiency. The centrifugal blower is about 74% efficient with the axial type at least 10% better than this.

But the centrifugal type blower has a place and probably will be retained for the moderately high-speed and relatively short-range passenger aircraft for inter-city airline use. Here, the diameter of the engine and specific power output will not be so critical. Therefore, a relatively long life for the centrifugal-type turbojet in this class of aircraft is foreseen.

Practical limit of turbojet blower pressure ratio would be in the order of 6 to 1, but might go to 8 to 1 for extremely high altitude operation (40,000 to 50,000 ft). Theoretical calculations suggest a maximum of 8 to 1; but in addition to increasing engine weight and reducing operational flexibility, the leaving velocity of the gas at the jet nozzle would increase and so reduce propulsive efficiency at presently contemplated speeds.

With turboprops, on the other hand, where power could be more usefully employed at the aircraft speeds envisaged, pressure ratio can be raised well above 8 to 1. But the added complication and weight would probably limit the pressure ratio to 12 to 1, unless blower design permitted a higher pressure ratio per stage than was at present possible.

In the British opinion, regeneration will result in dead weight plus complication. The Bristol "Theseus" weighs about 2500 lb, with a regenerator and 2000 lb without it. Although about 10% improvement in fuel consumption is realized, the additional weight to be carried on such a small engine is very high.

Gas turbines should have at least 90% air intake efficiency and a turbine efficiency of 90 to 91%, crediting leaving loss. While small differences in turbine efficiency are not too important with turbojets, a 2 or 3% drop in turbine efficiency on a turboprop may lower fuel economy by 9 or 10%.

Expensive materials containing rare elements are now being used for turbine discs and blading; but the same rate of improvement in materials cannot be expected in the next five years. Experimental work on ceramic coatings is in hand and offers some promise. But here, again, it will be some years before such coatings are generally used. Obviously we must eventually go to cooled blades to allow higher gas temperatures for more efficient gas turbines—particularly in the turboprop class. And, although nonferritic type materials are largely used at present, "availability" must be considered. This will demand ferritic materials, properly cooled.

The gas turbine's "Achilles heel" is its combustion chamber. This part of the engine still demands frequent inspection. Separate combustion chambers are generally used in British engines, but the annular type offers considerable advantages in reducing overall diameter and pressure drop. Such

a change, to the annular chamber, will be a matter of future development as more experience is gained in combustion generally.

On the question of fuel consumption, the figure for turbojets might be down to 0.9 lb per lb thrust in two or three years and 0.8 in about five years. It is hoped to have cruising fuel consumptions in the order of 0.55 lb per equivalent shaft-horsepower with turboprops and appreciably lower than this in the not too distant future.

Although fuel for military gas turbines, because of availability, might have to be of the inflammable variety, that for airline use could be of the heating oil or diesel fuel type and, therefore, relatively very safe. But the freezing point of the latter fuels will have to be lowered if they are to meet aircraft operating conditions.

Engine development still remains an art even now, after some 40 years. It is an art which makes use of technical and scientific aids. Aviation engine development should never stand still. No sooner is a prototype on the test-stand and another design should be on the drawing board. Aviation has not reached that stage where performance can remain static. Sound engineering demands that changes must be made in steps; but in aviation these steps are taken quickly.

The successful engine manufacturer will be one who learns to make and break engines quickly to achieve the desired results. The gas turbine is as yet a strange, newly-born machine and requires more preliminary theoretical calculation before getting down to its mechanical design than does the piston engine. When sufficient experience has been gained, by making and breaking many engines, it should be possible to design a gas turbine which will perform and behave as predicted, reducing development time. Currently this is not yet possible.

Another very important point in this type of work is that the development of an entirely new engine is much more important than production considerations. Designers must not be hampered with manufacturing problems in the early stages of design and development. Once the first engines are built and pass tests successfully, production specialists always manage to lick apparent manufacturing obstacles to quantity or series production, despite their early cries of it can't be done.

This is the only way to push aviation engine development to its ultimate. Obviously, all this costs an enormous amount of money. But if the military are to have the best aircraft to pace the field, governments must pay and must not allow those companies with engine-development know-how—the legitimate aviation engine manufacturers—to drop by the wayside or turn to other work because of financial inability to continue. Finally, dismissing valuable technical staffs because orders for new and advanced engines are not forthcoming will be nothing short of tragic... these people do not grow on trees.

USE and ABUSE of Heavy-Duty Oils

EXCERPTS FROM A PAPER* BY

**P. V. Keyser, Jr.,
G. A. Round, and
J. P. Stewart**

SOCONY-VACUUM OIL CO., INC.

THE relatively trouble free use of Heavy-Duty oils by the military forces during the recent war - to say nothing of the plethora of papers on the subject - has rather overglamorized that type of lubricant; too many operators have come to visualize such oils as cure-alls for all the ills to which the automotive engine is heir. Unfortunately those operators are doomed to disappointment, for Heavy-Duty oils are not quite that good; sound engine design, effective servicing, good overhaul practice and intelligent operation are still as important as the lubricant poured down the oil filler pipe.

The feature that identifies the Heavy-Duty-type oil is the presence of added chemical compounds that provide augmented detergent and oxidation resistance properties to the oil. The oil is designed to maintain engine interiors free of sludge and lacquer deposits, to reduce the sticking and fouling of piston rings and to minimize corrosion of hard alloy bearings. However, these characteristics are not present to an infinite degree and the simple change to a Heavy-Duty oil does not necessarily ensure clean engine interiors or the absence of bearing failures or operational interruptions. It is true that all Heavy-Duty oils are not at one level of effectiveness, but even the best of them cannot develop their full potentialities if other factors affecting engine performance are too unfavorable. Experience in the field has indicated some of the conditions that bring about disappointment in the results obtained and has dictated means by which such conditions may be overcome or at least ameliorated.

Bearing Failures

Corrosion of hard alloy bearings has practically vanished where Heavy-Duty oils have been employed, yet bearing failures still occur. Almost

invariably such failures can be traced to fatigue or to erosion due to dirt. These failures are often confused with corrosion failures, which they frequently resemble, and the oil is held responsible. The correction of the condition lies not in the oil but in those mechanical and service factors that are the direct but at times unrecognized cause - concentrated bearing loads due to overly flexible connecting rods or mal fitted bearings, or to carelessness in permitting dirt to reach the crankcase either at time of servicing or through operation with ineffective air cleaners.

Engine Deposits - Diesel Engine

The efficacy of the Heavy-Duty-Type oil in maintaining engine cleanliness varies with the type of unit and the conditions under which the unit is operated. With the modern automotive diesel engine the use of such oils is a "must." In no other way (even with normal operation) can the relatively large quantities of fuel soot reaching the crankcase be held sufficiently dispersed to prevent their settling from the oil onto interior engine parts. But consider the abuse imposed upon the oil when, because of engine overloading or injector malfunctioning, combustion is so inefficient that the unit trails behind it a black plume of smoke. No feasible concentration of the additive can cope for long with the abnormal volumes of soot reaching the crankcase under such conditions. The detergent is not inexhaustible, and where those conditions exist reasonable engine cleanliness can only be maintained by unconscionably short drain and filter change periods. The cure? A reasonable power development, that is, a fuel injection rate

*Paper "Heavy-Duty Oils - Use and Abuse" was presented at SAE Metropolitan Section, April 17, 1947.

that the engine can digest, balanced injectors or a more judicious selection of drive ratios to maintain optimum combustion efficiency, corrections that are largely up to the operator or to the engine builder if he has been guilty of overenthusiastic "power ratings."

Engine Deposits - The Gasoline Engine

In the gasoline engine the use of Heavy-Duty oil is not so definitely a "must" as with the diesel. Under moderately severe operating conditions Premium oils are quite satisfactory but under very severe service the Heavy-Duty oils have a potential advantage. Fuel soot and oil contaminants reaching the crankcase will be dispersed with resulting reduction in engine deposits. However, oversold operators frequently have inordinately lengthened oil drain periods, thus overloading the detergent with resultant disappointing performance. Such "abuse" is particularly serious after ring wear and loss of ring tension results in augmented quantities of fuel debris reaching the crankcase. The correction of the condition is obvious.

In the gasoline engine a condition also may exist with which the Heavy-Duty oil cannot fully cope; this is rendering innocuous certain products of arrested combustion of the gasoline. Such products are partially oxidized, frequently aldehydic in nature and are similar to the basic components of many synthetic paints and resins. The Heavy-Duty oil may hold such products in dispersion but it can only retard, not prevent, their further oxidation and polymerization to sticky resins which attach themselves to engine surfaces or form a binder for soft sludges. In such instances effective crankcase ventilation has accomplished much in removing those materials from the crankcase atmosphere. An improved ring condition is also a help.

Stop and Go Winter Operation

The efficacy of the Heavy-Duty oil in intermittent winter operation is a moot question. The problem is an elusive one, for a fleet having little difficulty one winter may be overwhelmed with "winter sludge" the next. These differences are mainly a reflection of service and maintenance practices and of engine condition.

Winter sludges are composed largely of products of arrested fuel combustion and water vapor that are absorbed by the crankcase oil; steps to improve combustion efficiency and to remove continuously such products from the crankcase atmosphere are of prime importance. Jacket temperatures of 160 F, preferably 180 F, and an effective crankcase ventilating system are essential to satisfactory operation regardless of the type of oil used. Many ventilating systems are far from effective, depending as they do on vehicle road speed; what is needed is effective ventilation at low road speed and during idling. In "stop and

go" service, optimum operating conditions are a prerequisite to even a consideration of possible benefits to be derived from the use of Heavy-Duty oils.

The above discussion covers only too briefly instances of service, maintenance and design malpractice that actually abuse the oil in the engine crankcase and prevent it from developing its full potentialities. Correction of such malpractices, where they exist, is a prerequisite to the optimum in engine performance. Excellence in no one of the several factors governing engine performance can substitute for mediocrity in others.

MODERN TECHNOLOGY

continued from page 23

ever before are now obtainable. This also reduces combustion volume.

Reading a few pages from the instruction books for such cars as the Stanley and White steamers would readily convince anyone of the mechanical complications and gadgetry of these vehicles. But this need not be a necessary evil of the vapor-powered vehicle.

Classical design, using two double-acting cylinders of the piston-rod type with a link motion and 90-deg cranks, made optimum balance impossible. Inertia of the link system and rod assembly limited engine speed to about 1000 rpm and the arrangement lacked inherent balance.

Vapor powerplant design must turn over a new leaf and follow automotive design principles. This implies the use of trunk-type pistons and connecting rods, cam-actuated poppet valves, pressure lubrication, and other distinctly automotive practices. Adopting such present-day engineering should allow speeds approximating 2000 rpm without posing any new problems.

Although not limited to any specific vehicular application, similarities between diesel and vapor cycles suggest vapor engines for intercity buses and trucks and heavy military vehicles. The vapor powerplant could be especially useful where frequent gear shifting is necessary, as in urban bus service and truck operations where steep grades are encountered.

And the ability to burn low-cost liquid fuel may offset the higher fuel consumption possible in some classes of service.

Proposed Research Seeks to Improve CAB COMFORT



BASED ON PAPER* BY

AMOS E. NEYHART

Administrative Head, Institute of Public Safety; Consultant to AAA

and C. G. SEASHORE

in Charge of Fleet Safety Education, Institute of Public Safety, Pennsylvania State College

CAB IMPROVEMENT, to increase driver comfort, and hence to promote safe, efficient operation, has become a must for truck design in the immediate future.

Research data analyzed during the past decade indicate that, while better seating is paramount, the following also are important factors for bringing about this improvement: Better visibility, temperature conditioning, sound insulation, more accessible and better controls, better lighting, functional hardware, and built-in containers for accessories in the cab.

Approximately \$40,000 has gone into planning a proposed research program to determine basic design factors to improve driver comfort, and a projected procedure has been developed for a Comfort Research Study with the cooperation of the White Motor Co.

"Human dimensioning" studies of the Army Air Forces, research work bearing on this problem by automotive, rubber, electrical, glass, seating, and other manufacturers were investigated, as was work done by the Army and other Government agencies.

Objectives of the study were:

1. Determining, through anthropometrical measurements, the special requirements of commercial truck drivers. This would lead to recommendations for the human requirements of cab design.

2. Locating and operating planes and loads of the manual and pedal controls used by commercial drivers.

3. The achievement of Comfort-Safety human relationships, such as have been brought about in the newer airplanes, because of considering the human (pilot) dimensional requirements first, and designing the rest of the operator's compartment around him.

In general, the purpose is to determine the human spatial requirements for the comfort and safety seating of truck drivers. This will involve a comprehensive two-hour seating test of some 500 truck drivers during which time basic seat information regarding adjustments, pressures and movements will be recorded for later analysis to determine loaded seating contours to accommodate a predetermined percentage of the truck driving population.

Supplementary measurements will be made of some 3000 subjects selected as to geographical and truck driver population distribution. An analysis of these findings will provide basic posturing information around which the individual designer could work.

* Paper "Seating and Other Aspects of the Driver's Environment," was presented at SAE Summer Meeting, French Lick, Ind., on June 3, 1947.

The automobile manufacturing industry progresses only as its customers prosper. Satisfactory vehicles must be manned by drivers who are not only proficient in driving skill but who also are happy and content in their "home-on-wheels." Basic industrial relations demand that we know the other fellow's viewpoint, recognize his feelings, and take action to give him the satisfaction to which he is properly entitled.

The armed services are engaged in a tremendous (anthropometric) study involving some 100,000 men and about 13,000 women to determine basic specification data for equipment and material in which human usage is concerned. This study will uncover information regarding spatial seating requirements of military vehicles, and your industry will produce those vehicles.

The Army Air Corps has found it desirable to determine and provide for the human dimensional and comfort requirements of their fighter pilots, and human dimensioning is the first step in cockpit design. Engineering features are then incorporated with deference to the human requirements. Pilot specifications are definite in the Air Corps, specifically with regard to sizing.

Sizes Predicted

Good management in the truck and bus industry is more and more setting up driver specifications which make it possible to predict the size, shape, age, and so forth of the current and future commercial drivers.

Visual design factors are wholly dependent upon the eye level, which again is dependent upon the contour of the seat under load and the sizing of drivers who will operate the equipment. Placing rear quarter windows in the cab thus depends upon the loaded seat contour.

Major groups or individuals would be involved in the proposed research project:

A laboratory team to man the traveling mobile laboratory, to conduct the required interviews, and measurements, and to operate the equipment at rest enroute. Job descriptions for these men are: A consulting anthropologist; the Institute of Public Safety of The Pennsylvania State College represents the educational group which initiated the survey and presumably would be responsible for carrying through a survey to successful completion; and the sponsor or sponsors of the project, without whose financial backing there can be no project.

The van type laboratory would have an airconditioned compartment permitting tests under standardized conditions irrespective of outside temperatures in any section of the country. In the rear would be a revised version of the universal test seat developed by Fisher and Lay.

A moving picture film is on hand which will keep the driver under test awake. He will be asked to

keep the film in correct relation in front of his normal line of vision with a steering wheel.

Full time tests would be made on 500 subjects, and briefer tests on 300 for the substantiation of the results of the first group of tests.

There is no easy path to good seating. The suggested approach might be a step toward the reduction of accidents on the highways and to the formation of better employee and public relations on the part of the commercial vehicle industry.

The public interest is the best public relations, and the automotive industry has the opportunity to take this step of its own volition rather than being forced to the action through laborer armed service pressure. We, of the Institute of Public Safety, will be happy to participate in this research if called upon to do so.

Other Factors

Development of truck cabs has been a slow process to date.

Early trucks had hard seats with flimsy cushions containing few or no springs. The "lazy back," which supported a few inches of the driver's back, and which bounced up and down on his kidneys with every jolt, was not much worse than some of the so-called "comfort" seats of drivers today.

Canvas tops, and curtains, with two pieces of celluloid, sufficed. Then came the unsatisfactory half doors, and years later the permanent top, windshield, and doors with glass in the upper half.

Improved Visibility. Better cab vision is essential and all cabs could be improved in this respect. Even with the cab-over-engine jobs, where it would seem that vision would be at its best, the designer has not used sufficient glass, or has placed posts and framework at an undesirable location.

Position of cornerposts in relation to the seated driver is important and deserves further study. A large blind spot where the door frame and cornerposts meet at the roof hampers tall drivers. Additional research is needed to reduce the size of front cornerposts, taking full advantage of stronger alloys. Visual distortion through curved glass should be avoided.

Windows should be kept clean and free from "fogging." Some attention should be given to defrosting methods for all windows. Many intersectional and other accidents from the sides are caused by poor visibility to right and left. Water repellent coatings may help.

An automatic windshield wiper which can be depended upon to work at all times, and which will really clean the windshield is needed. There should always be one on each side of the front windshield. Two sun visors should be included as standard equipment for an added safety feature.

Dependable defrosters are imperative for those operations which cannot wait for favorable weather. Experimental defrosting and antifogging devices may be possible solutions. Improved rear-

view mirror on each side of the truck is favored. The mirrors at present are not large enough, fail to reflect accurately in needed directions and areas, and are so poorly constructed that often they have to be wired together after several months of use. They should be adjustable and stable.

Better Cab Conditioning. No truck cab in service today has a heating and ventilating system even remotely adequate. A driver is usually too hot or too cold. Heat should be controlled to maintain even temperatures in the coldest weather and at the same time fresh air should be automatically introduced.

Cab Temperature Control

The cab temperature should be controlled by a thermostat, adjustable by the driver, to maintain the desired temperature regardless of outside weather and engine heat.

Insulating the roof of our cabs to keep out the summer heat will improve conditions for only a few hours. While heat pours in the temperature in the insulated vehicle will continue to rise until equilibrium with the outside has been established. This occurs whether the roof is insulated or not. When vehicles that have been parked are set in motion, it again makes no difference whether the roof is insulated.

When the cab is air conditioned, however, when the inside is cooler than the outside air, insulation is important because the load on the refrigerating equipment is reduced. Conversely, when a heater is used in cold weather, loss of heat through the ordinary roof accounts for a substantial used part of the heat load.

Sources of heat admittance, other than windows, must be considered. When cars are in motion the heat from engine seeps through cracks and crevices around doors and holes or openings in the dash or floor. The heating and ventilating problem is a difficult one, but must be solved to achieve higher operating efficiencies. In addition, the exhaust system sends power heat radiations against the floor.

Improved Sound Insulation. Traffic authorities attribute over 75% of our truck accidents to failure on the part of the driver. Of the 11,296 truck accidents reported to the ICC in 1945, only 10% or 1124 were classed as being due to mechanical failures. Total fatalities of this classification were 111 and property damage reached \$1,710,404.

In many cases of the other 90% the drivers were accused of falling asleep.

An Allied Air Command study of fatalities of combat pilots, who failed to make safe landings at their home bases following otherwise successful missions disclosed excessive fatigue was induced by high noise levels. These noises, usually masked by noises in the lower ranges, increased the pilot's reaction time. It seems reasonable that many truck accidents are due to this condition resulting

in fatigue and lag in the drivers' reaction time.

The detrimental effect of noise on human fatigue has been recognized for some time. Studies involving neuro-muscular activities show that dexterity increases with a decrease in noise. All these findings indicate that a quieter truck would be a safer truck. The kind of cab the industry builds influences legislation under which that vehicle must operate.

More Accessible and Better Controls. The general standardization of location of foot pedals should be continued. Mechanisms such as clutch, brake and accelerator pedal, steering wheel, gear-shift lever, and horn button should be placed for the maximum ease and convenience of operation, with standardization of positioning.

The shift pattern will gradually be standardized on all trucks, so that a driver won't need a blueprint to drive a different make of truck.

We are reaching the end of the straight mechanical gear for steering and there is a necessity for the quicker and easier control in future vehicles. It would be wise to consider the development right now of suitable power steering gears.

More Legibility Needed

Uneven balance of the brake and clutch pedal pressures has been overlooked. In some instances brake pressures are approximately 15 lb, yet clutch pressures are 80 or 90 lb. There is need for a hand brake lever which is easy to reach, mounted in a standard position and operated by pulling back.

Gages and dials should be designed and placed for quick-glance legibility, with serious consideration of standardized location on all types of truck, but without necessarily standardizing the dash-panel design.

When controls can be located so that the driver can reach them easily, quickly and accurately, truck transportation will step to the next level of efficiency.

Better Lighting. The truck drivers who pound the road at night are plagued by the dazzle of oncoming headlights. If all of the 30 million vehicles on the road had properly aimed headlamps closely regulated as to intensity, and they all had polished lenses and clean lamps, there would be some measure of relief.

Better Cab Hardware. Cab hardware is simply borrowed from standard passenger car design. The construction is not sturdy enough for the truck cab particularly for multi-stop delivery because of the frequency of the use of door handles.

Containers for Accessories. Integral units should be designed and built into the cab to house flares, fire extinguishers, driver's records, and other necessary accessories. Provision of proper storage facilities would heighten the driver's self-respect, and would improve his attitude toward his vehicle and the public.

Fitting Off-the-Road Vehicles

RENEWED activity in construction of dams, airports, superhighways, and replacement of railroad right-of-ways is focusing attention on off-the-highway, rubber-tired hauling equipment that services these operations. Aside from special vehicles, fairly uniform elements — each fitted to specific uses — make up current units.

Prime movers for construction work are of two basic types. First is the 4- and 6-wheel type with conventional automotive front axle, used either with a dump body on the chassis or to pull semitrailers. Second is the single-axle, 2-wheel construction with the engine overhanging ahead of the axle.

Load-on-back vehicles of the conventional type range in size from the light highway type dump truck to as large as 160,000-lb gross vehicle weight machines that are specially built. Most popular heavy-duty trucks are powered by 150 to 275 hp engines, have 15 to 22-ton capacity, and are used for general hauling in construction work and for stripping or hauling ores and stone in quarries.

Trucks of this type are built with both single and double-drive axles. Unpopularity of the 6-wheel drive stems from their high maintenance costs.

Most of the semitrailer types are of the bottom-dump type for hauling dirt or coal or similar free-shredding materials. The most popular trailers haul dirt on dams, levee roads, airports, and also overburden in mines. They vary in size from 12 to 40 tons and are usually equipped with large single tires for maximum flotation.

Semitrailer type scrapers may be attached to the same prime mover and usually have large single tires. The same 4-wheel prime mover can be used with side-dump trailers to handle rock and dirt.

With semitrailer type vehicles, 44% of the gross load is the maximum that can be placed on the drive axle. The front axle carries 12% and the trailer axle the other 44%. Under many conditions this prime mover provides insufficient tractive effort. Some manufacturers promoted 4-wheel drive prime movers to overcome this deficiency. But these machines are expensive both to buy and

to maintain. The 4-wheel prime mover has good traction at high speeds and is at its best operating over well-kept roads.

Two-wheel prime movers pull either scrapers or simple hauling units. This type has the advantage of high tractive effort. Some 60 to 70% of the gross load is on the driving axle as compared to the maximum of 44% on the 4-wheel trailer with single-drive axle. Two-wheel prime movers have proved successful at moderate speeds and under difficult ground conditions. Difficulties with this machine are with control and poor riding at high speeds.

Such units usually ride on large, low-pressure single tires. Considerable overhang of the engine over the drive tires gives good weight distribution and design simplicity. But the combination of

Discussers

■ Tires

M. A. Wilson, Goodyear Tire & Rubber Co., strikes at overload as a principal threat to tire life. He says careful selection by the vehicle manufacturer of tire sizes and ratings, ample for all potential large loads allowed by vehicle body size, will help reduce overload and improve tire performance.

Off-the-highway vehicle tire equipment runs 15 to 25% — and sometimes higher — of the total vehicle cost compared to 4 or 5% for passenger cars.

■ Rims

Off-the-road vehicles lack some form of ready-to-use inflated spare tires and operators face costly delays in removing a tire at the place of failure, declares W. S. Brink, Firestone Steel Products Co. Equipment for changing the tire, lifting the truck clear of the ground, and inflating these tires is no small factor.

Brink urges that an SAE committee undertake a standards program aimed at interchangeability of demountable rim equipment.

* Paper "Rubber-Tired Hauling Equipment for Off-the-Highway Service," was presented at SAE Summer Meeting, French Lick, June 4, 1947.

to the Job

BASED ON PAPER* BY

H. L. Rittenhouse

Chief Engineer, Euclid Road Machinery Co.

overhung weight and large, low-pressure tires may result in loping, which limits speed and hampers steering control.

Choice of hauling equipment depends largely on the material to be hauled, job requirements, and loading equipment. Bottom-dump hauling units have the advantage of being fast on the haul road, quick in discharging load, relatively light weight, mechanically simple, and economical to operate. In those applications suited to them, bottom-dump units haul cheaper than any other equipment. But sometimes high loading costs offset this economy.

Scraper operation fills the bill for most excavation in road work, levees, and airports. Hauls are usually down hill from cut to fill. When dumping, the scraper will spread its own load. Cost of moving dirt by this method is low for hauls under 700

ft. On longer hauls, speeds higher than those available with crawler tractors are necessary for operational economy.

Rubber-tired scraper-tractor combinations move dirt very economically on hauls from 700 to 3000 ft. But they are heavier and more expensive to operate than bottom-dump hauling units. As the haul length increases, it becomes questionable whether it pays to penalize the hauling vehicle by having it carry its loading equipment.

In addition to these fairly standard vehicles, several very successful ones have been built for special jobs and operations. Freed of wartime restrictions confining production to existing models, manufacturers in this widening field are transforming new ideas into working equipment for an eager market.

Spell Out Component Needs

■ Engines

The rough treatment these vehicles get in day-to-day service demands rugged construction and a high safety factor in every part, including the engine, H. G. Smith, Buda Co., points out. For this reason, engines suitable for on-highway use will not meet off-highway requirements, unless modified.

Operators concerned with more-power-per-ton rather than weight will require considerably larger displacement engines to meet this demand.

■ Transmissions

In off-the-highway service, ratio of unused to maximum available horsepower is unity, says J. A. Watts, Cummins Engine Co.

Since maximum speed of units steered by the driving axle is about 15 mph, Watts recommends a 4-speed transmission to keep weight and cost down. Positive-steering units designed for higher speeds should have larger transmissions with at least five speeds.

■ Steering

Discussing power steering, W. K. Creson, Ross Gear & Tool Co., discloses the maximum drag link forces found in testing Euclid Model 12 TD trucks on strip-mining operations under these conditions:

1. Hauling ore over ordinary haul road from pit to tipple - 4200 lb;
2. Hauling overburden over rough haul road - 6100 lb;
3. Hauling overburden on rock and driving truck into and over 30-in. fill embankment - 7500 lb.

■ Other Vehicles

M. C. Horine, Mack Mfg. Corp., describes the superduty characteristics required of oil field equipment. These behemoths must have exceptionally long wheelbases and multi-axle construction. The long wheelbase provides both ample load space for bulky equipment and stability for winch work.

Used for rapid movement of oil-drilling equipment, these trucks are regarded as production tools rather than vehicles.

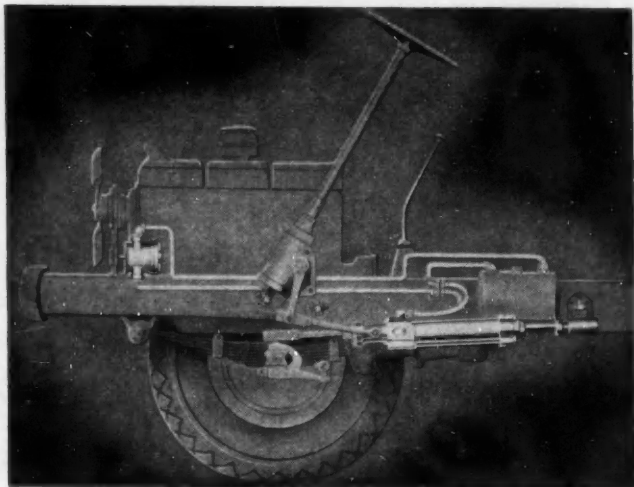


Fig. 1 - This hydraulically-powered steering installation requires little driver effort. An improvement over previous hydraulic steering configurations, this system put in over 75,000 miles of service in a Detroit Street Railways coach without requiring any maintenance

HYDRAULICALLY-POWERED steering and accessories offer the automotive engineer a reliable way of meeting the operator's demands for improved performance, simplified design, and reduced maintenance. These devices also take a lot of drudgery out of truck and bus driving.

Power steering for automotive vehicles has been accomplished successfully only by the hydraulic method. The background of power steering in automotive work is as long and as successful as that of the power hydraulic industry; but its field of application has now been widened with the introduction of a redesigned system on which increased production has resulted in lower costs.

The hydraulic units for this redesigned power steering system consist of a pump and a steering booster assembly which incorporates a hydraulic cylinder, a servo control valve, a safety overload valve, and a check valve. These two units are designed for installation as original equipment or in the field.

In a typical installation, Fig. 1, the piston rod of the booster assembly is anchored to the frame which takes the entire steering reaction; the drag link is connected to the movable cylinder body so that it is actuated by the hydraulic cylinder; and the Pitman arm is connected to the booster servo valve control so that the cylinder movement can be directed from the steering wheel. The pump is engine-driven and delivers oil continuously to the booster.

With this arrangement, the only direct function of the steering wheel is to actuate the servo control valve in the booster assembly, which in turn regulates and directs the oil supply to the booster

* Paper "New Hydraulic Applications for Tomorrow's Automotive Designs," was presented at SAE Detroit Section, April 21, 1947.

HYDRAULIC Meet Needs

cylinder to do the actual steering. Within the system's capacity, the steering booster cylinder will follow Pitman arm movement exactly in direction, distance and speed, taking 100% of both the steering load and the shock loads.

The pump is unloaded when no actual steering is being done. During steering the oil pressure corresponds to the actual steering load. The system is arranged so that mechanical steering takes over automatically if the hydraulic system is not functioning, as for example, when the engine is not running.

This redesigned power steering system has been test-proven on all types of installation over the past 18 months. Typical of the service records of these installations is a Detroit Street Railways coach which has required no maintenance on the hydraulic power steering system in the more than 75,000 miles accumulated to date.

A vehicle equipped with this type of power steering assures the driver complete steering control under all conditions, with no more effort at the steering wheel than is required to shift the servo control valve. Steering reaction and shock loads are transmitted entirely to the frame.

Where to Use Power Steering

Most power steering applications have been made on heavy off-the-road vehicles or where steering could not be accomplished without power. Automotive engineers in general agree that power steering must eventually come into wider use, but many vehicles are still being built with mechanical steering where power steering should properly be applied.

At best, mechanical steering on buses and trucks is dangerous because it is the only important function of these vehicles which still depends on the driver's strength for control, but which continually encounters conditions beyond the physical capacity of the driver.

Power steering is the only adequate answer for

STEERING and ACCESSORIES of Operator and Driver

EXCERPTS FROM A PAPER* BY

Merrill A. Hayden

District Manager, Southern Area, VICKERS, INC.

heavy trucks and buses. It can improve both safety and operation by:

1. Taking the entire steering load and permitting full steering control under all conditions without effort by the driver;
2. Entirely eliminating reversibility of the conventional gear so that all road shocks and steering reactions are transferred to the frame instead of the driver.
3. Permitting the use of any steering ratio and steering wheel diameter deemed desirable;
4. Allowing lighter construction of the mechanical gear because all steering loads are normally handled by power equipment;
5. Permitting as high an increase as possible in front-axle loading, which could change the trend in truck and bus design;
6. Eliminating driver fatigue by minimizing both the driver's physical effort and mental anxiety.

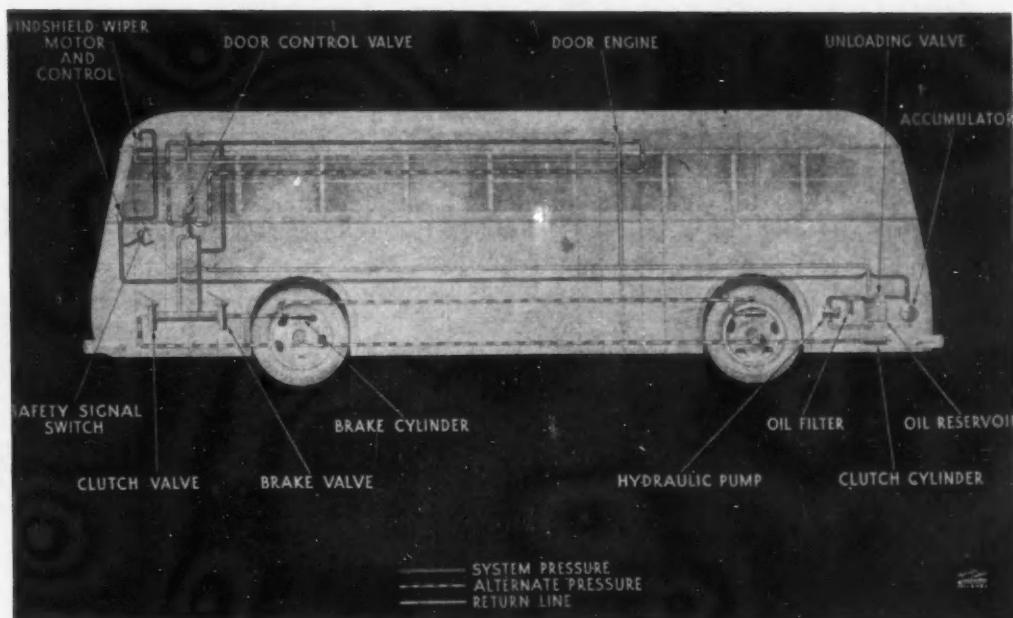
A totally new hydraulic development within the past few years is a hydraulic power system for brakes, clutch, windshield wipers, doors, torque converter controls, shutter controls, and other truck and bus devices. This is a field for which hydraulic power equipment is well suited.

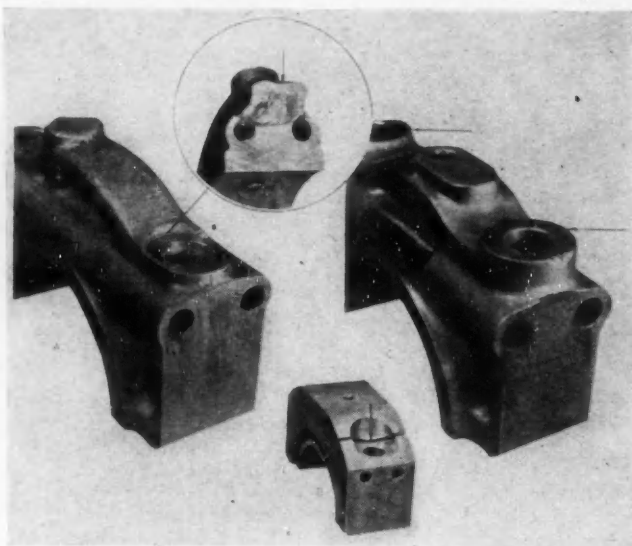
One of the earliest experimental hydraulic installations in this field is on a Ford coach operated by the Detroit Street Railway System. This installation has been in regular D.S.R. transit service for 20 months. In the hydraulic system on this coach, Fig. 2, the brakes, doors, windshield wipers, and clutch are actuated and controlled by hydraulic power equipment.

The hydraulic power supply system for this coach consists of an engine-driven high-pressure oil pump, an accumulator for oil storage under pressure, and an oil reservoir which incorporates an unloading valve.

concluded on page 50

Fig. 2—In 20 months of service, this experimental coach's hydraulic accessories demonstrated such virtues as all-weather operation without freezing, carboning, or condensate problems; silent operation; automatic self-lubrication; high-efficiency requiring less engine power; more accurate control, and instantaneous response without secondary units.





Stress Raisers should be eliminated and metal redistributed where necessary to provide the part with proper geometry.

This is an illustration of the design changes made in the XI-1430 engine's main bearing cap. High tensile prestress in the spot-face area of cap "A," left, resulted in fatigue failure. Cap "B," center, was "beefed up," weighed 50% more than cap "A," but also failed in the spot-face area.

Raised bosses were provided in cap "C," right, removing the high tensile prestress. This third redesign eliminated the possibility of failure without any increase in weight, whereas the heavier cap had failed.

In another case, metal removed from a radial engine crankshaft increased its endurance strength 97.5%, at the same time reducing its weight.

Sound Engine Design

BASED ON A PAPER* BY

W. T. BEAN, Jr.

Continental Aviation & Engineering Corp.

Geometry of a part determines its stress distribution. Achieving good stress distribution eliminates stress concentration. It's a mistake to add metal blindly at or near the point of failure.

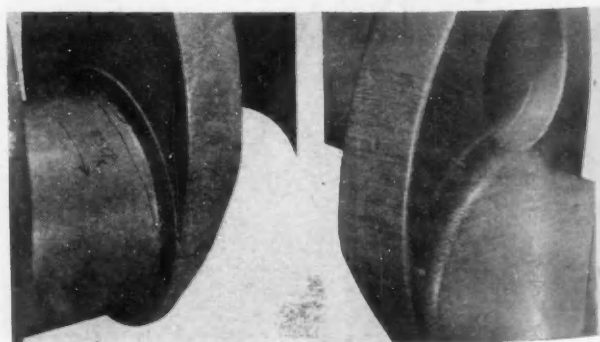
Because of the engine design criterion of "when a part fails, it's too light - when it doesn't fail, it's too heavy," weight became erroneously associated with endurance strength and strength was always marginal.

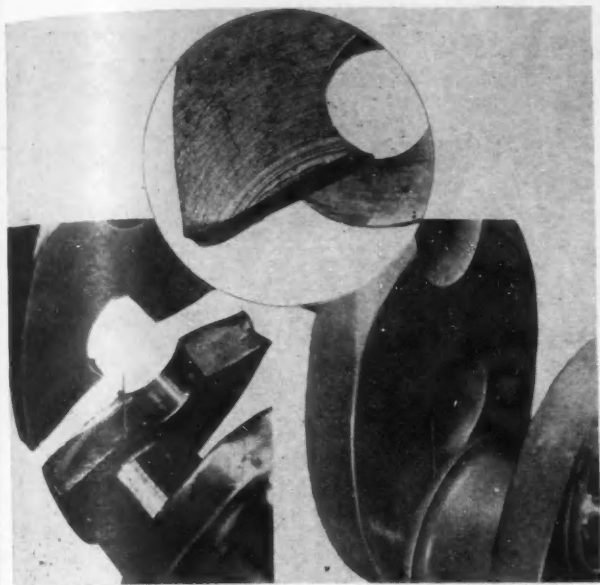
With the new approach to design, it was found that "beefing up" a part at a critical area increases cross-sectional area, but it doesn't necessarily reduce the stress concentration inherent in the part. Stress distribution of many engine parts are improved by removing metal from critical areas.

In the photograph at right, the stress distribution of a conventional automotive crankshaft, left, is compared with that of the XI-1430 crankshaft, right. While the magnitude of fillet stresses are

comparable in each design, note the difference in stress distribution.

The automotive crankshaft delivered 1 bhp per lb of crankshaft weight; the aircraft crankshaft delivered 20 bhp per lb. It was designed with hollow pins and journals, large fillets, and well-blended sections. Oil holes were removed from critical areas.





Processing for high endurance strength is as important as the design itself. A good design can fail if improperly fabricated.

A Stresscoat diagnosis was made of the crankshaft failure shown at left. While the shaft broke from a bending load, tensile stress from a simulated engine load was not high enough to cause the failure. Strain measurements under actual engine operating conditions verified this.

Only possible explanation of the failure was that improper machining considerably reduced the material's endurance strength. Fatigue failure had occurred at a point where the machining marks were parallel to the maximum principal stress in the shaft. Shot peening could have healed the damage by placing the rough surface under a compressive residual strain.

Thwarts Parts Fatigue

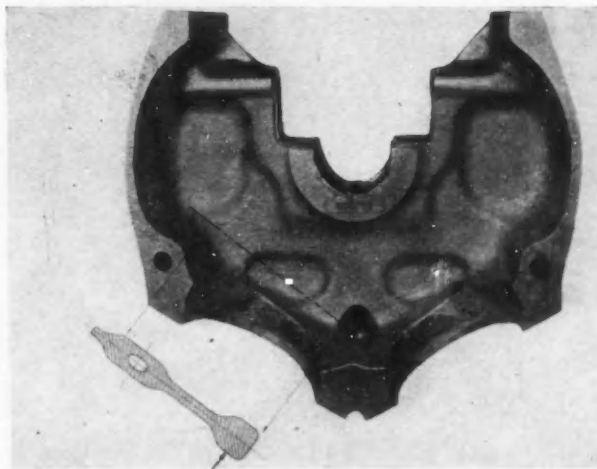
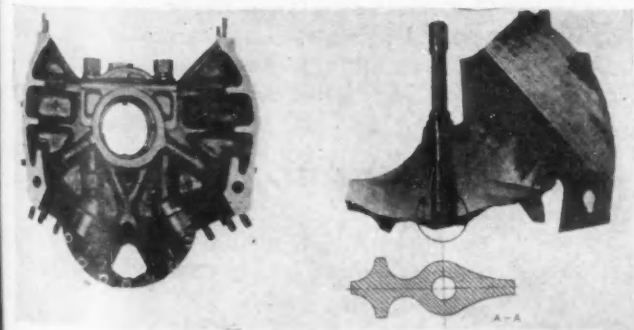
Proper Stress Distribution Extends Life of Plane Engine Components

Failure of this original XI-1430 crankcase, with well-ribbed sections, was due to stress concentration in the aluminum casting at the end of the stud. Stresses from gas and inertia loads were transmitted from the bearing cap, through the studs, and directly to the cylinder deck.

After several attempts to change the stress path from the stud to the cylinder deck and after remov-

ing metal from the critical area, the ribless design shown was evolved.

Elimination of side-wall ribs and redistribution of metal produced a stronger, stiffer, and lighter case that cost less to produce and was easier to cast and to clean.



* Paper "Endurance - A Criterion of Design," was presented at SAE Peoria Section, Nov. 12, 1946.

PROBLEMS OF

THE helicopter is very fussy about its powerplant. It requires the engine designer to build in special characteristics in the way of weight, general configuration, cooling provision, power, and dynamics of the power train if his powerplant is to be suitable for helicopter use.

The helicopter might have been one of the inventions of Leonardo da Vinci, that fifteenth-century five-letter man who found time for inventing as well as for painting, sculpturing, mathematics, and poetry. He designed a battering ram for knocking down enemy scaling ladders, but his aeronautical activities apparently did not go beyond sketches and rudimentary models. Some specialists in the field of conjecture believe that da Vinci might have built a practical helicopter - if he had had a suitable powerplant.

The development of the helicopter had to wait for an engine light in weight for its power. There are two ways of achieving light specific weight:

* Paper "Problems of Helicopter Powerplants" was presented at SAE National Personal Aircraft Meeting, Wichita, Kans., May 1, 1947.

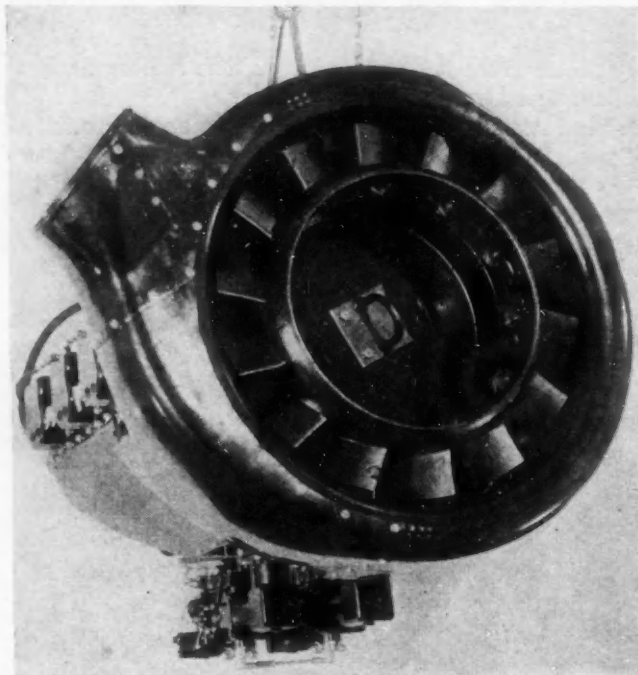


Fig. 1 - Aircooled Motors O-405-9 helicopter engine showing fan mounted on power shaft

1. Power can be increased without increasing weight.

2. Structural weight can be reduced without reduction in power output.

The first goal could be reached by raising manifold pressure through supercharging, but the extra complication usually is considered not worth while. The speed reduction mechanism between the engine and the rotor offers an easier way. By using a higher reduction ratio, the engine designer can redesign an airplane engine to run at higher speeds in a helicopter than it did in fixed-wing aircraft, because the rotary-wing aircraft is not limited by the same propeller characteristics that limit the fixed-wing aircraft. Therefore, an engine may have a higher power rating in a helicopter than in a fixed-wing airplane for the same engine weight.

Reduction in structural weight can be accomplished by using lighter materials. Substitution of magnesium for aluminum in crankcase and accessory-case castings is one of the best and cheapest means of reducing weight.

Not many months ago, the use of magnesium in highly stressed castings, although common practice in Germany and England, was discouraged in the United States because cast magnesium was supposed to have poor fatigue properties. Now new magnesium alloys and new design knowledge gained through the use of stress-coat and strain-gage techniques have made magnesium much more attractive to the designer. Extensive use of magnesium is already being made.

It has been found that a magnesium part can equal or surpass an aluminum part in strength and save up to a third of the weight. In a crankcase for a 250-hp engine, 20 lb can be saved with no sacrifice in strength and little increase in cost.

The per-pound price of magnesium is still well above that of aluminum, and the piece price of magnesium castings is slightly above that of aluminum castings. It is the superior machinability of magnesium and the resulting lower labor costs that offset the higher material cost. Weight reduction can be improved by machining lightening holes and scallops in magnesium parts. Such extensive machining, however, is expensive and not always worth the extra cost.

Just what can be accomplished in reducing spe-

HELICOPTER POWERPLANTS

FROM A PAPER* BY

ROBERT INSLEY

Vice-President, Chief Engineer, Continental Motors Corp.

cific weight by raising engine rpm and using magnesium is illustrated in Table 1. The Continental O-470 helicopter engine is compared with the Continental E-185 airplane engine. The two engines are identical in fundamental structure, but the O-470 engine employs magnesium wherever possible and is operated at a crankshaft speed of 3200 rpm. Weight figures do not include fans.

The evolution of the helicopter, like any complex article of merchandise, seems to show three general stages:

1. The original conception and production of an elementary article to satisfy a need.
2. The creation of a large number of variants of the original article to satisfy various interpretations of market requirements and to avoid patent coverage.
3. The elimination of all but a very few models or types.

The helicopter seems now to be in the second stage; it is appearing in a number of different forms. The chief variants are the number and

these variants, especially the type of engine in demand.

The inherent lightness of the radial-type engine favors its use in helicopters. The form of the radial engine makes possible the use of a simple cooling arrangement, but the same characteristic makes it clumsy to install, particularly with crankshaft vertical in small helicopters.

Where they can be fitted in, radial engines have been found to operate more successfully with crankshafts vertical than in the conventional horizontal plane. Vertical installations do require special accessory oil seals. Large helicopters, whose installation space is not too restricted, will probably continue to rely on the radial engine, at least

Table 1 - Comparison of Continental O-470

Helicopter Engine with Continental E-185 Airplane Engine	O-470	E-185
Bore, in.	5	5
Stroke, in.	4	4
Piston Displacement, cu in.	472	472
Rated Power (Gross), hp	270	185
Rated Speed, rpm	3200	2300
Bare Weight, lb	304	340
Weight-Displacement Ratio, lb per cu in.	0.645	0.720
Specific Weight, lb per hp	1.111	1.840

location of rotors and the number, position, and type of engine. There are single and dual rotors, tandem and side-by-side rotor arrangements, single and dual engines, vertical and horizontal crankshafts.

The engine designer must watch trends in all of

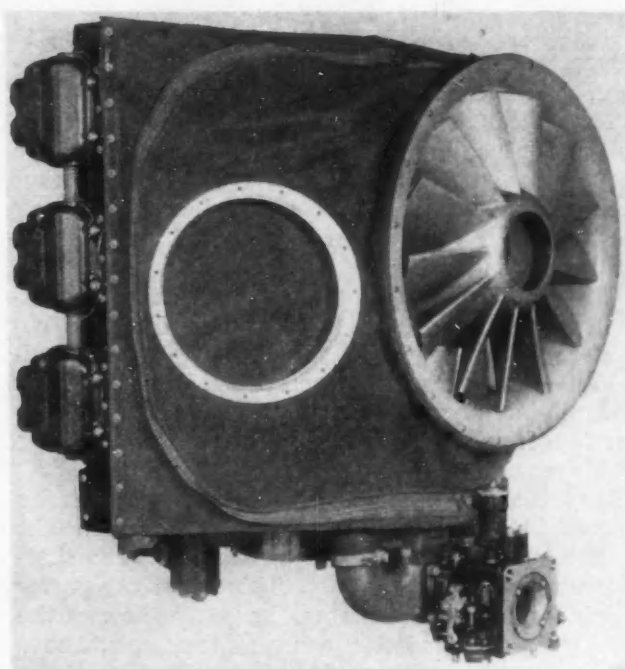


Fig. 2 - Continental O-470 helicopter engine showing transverse-mounted fan

until the gas turbine powerplant is ready for this type of service.

Most current small helicopters are powered by opposed engines. The selection was made probably on the basis of the availability of suitable opposed engines and the willingness of their manufacturers to cooperate in helicopter programs, rather than on the suitability of the opposed type.

Upending the opposed engine has caused serious lubrication difficulties. Oil drains down around cylinder barrels and on to rapidly moving crank throws, connecting rods, and accessory gears. The result is hot, foaming oil and, therefore, a more difficult breathing and accessory-sealing problem.

Some of the trouble has been overcome by shielding drainage passages to direct oil away from hot surfaces and moving parts. Adoption of deep sumps and double oil seals has helped further. These rather important structural changes in the engine were made necessary by the change in engine attitude—a change that at first seemed to be a minor change in operating condition.

The engine designer who is successful in adapting an existing small opposed airplane engine to helicopter use with only minor external modifications will bring about impressive savings in manufacturing costs. The small demand for helicopter engines means manufacturing costs will be high unless the engine is built and used for other purposes too.

Engine Cooling

Cooling the engine is one of the chief helicopter powerplant problems. Rotary-wing aircraft provide flight-induced cooling draft only under conditions at which the engine cooling requirements are lowest. Hovering, the most valuable manoeuvre of the helicopter, demands full engine power but involves zero vehicle velocity. Therefore, the engine must provide its own cooling.

The engine-driven fan has been the most popular means for cooling. The fan may be mounted on the power shaft of the engine, as in Fig. 1, so that it forces air axially into the cylinders. Or it may be mounted as shown in Fig. 2 so that it blows air across and between the cylinders.

The shaft-mounted fan has the virtue of simplicity both in manufacture and in dynamic behavior. The transverse fan, because of its latitude in design operating speed and dimensions, is likely to have better efficiency. The location of the fan is often determined by the space available within a particular helicopter.

In future installations, the engine-driven fan may yield its place to the exhaust ejector. The ejector supplies cooling by utilizing power otherwise wasted in the exhaust. This saves the power which would be taken from the engine to run the fan. Before the ejector comes into use, someone must solve the problem of muffling it.

Responsibility for cooling the engine rests on both the helicopter designer and on the engine

designer. Perhaps, it would be a good idea to have the engine designer concentrate on supplying cooling air around the engine and oil cooler, and the helicopter designer concentrate on providing a healthy environment for the engine with a properly ventilated compartment to avoid fuel vapor lock and with precautions against recirculation of cooling air.

The helicopter imposes unusual power requirements on its powerplant. Vertical ascent, hovering, and vertical descent all call for full power. The fixed-wing aircraft requires full power for only one normal flight condition—take-off. The engine manufacturer must make sure that any of his airplane engines used in helicopters can stand the more frequent full-power operation.

Valve gear and bearings for helicopter use may need more careful design than they get for fixed-wing aircraft use. The reason is that the helicopter rotor, being essentially a constant-velocity wing, not only demands more frequent full-power operation but also requires the engine to run at practically full-power speed throughout the range of its powers. And the speed of most airplane engines used in helicopters has already been stepped up to give more power per pound of engine weight.

Another condition adding to problems with valve gear and bearings is the overspeed capacity needed. Atmospheric density reduction at altitude necessitates an overspeed capacity of at least 10% to prevent rotor stall.

The helicopter power train requires a flywheel, a clutch, an overrunning clutch, a speed-reducing transmission, a rotor mechanism, and, ordinarily, a cooling fan. A counter-torque tail rotor and a supercharger may be present to complicate the situation further.

Some preventive mathematics expended on the dynamics of the power train is well worth the effort. Fortunately, the dynamic peculiarities of the most complex helicopter power train can be resolved on paper with sufficient accuracy to disclose the chances of encountering any dangerous resonant conditions. No possible contributing factors or possible operating conditions can be overlooked safely.

The cost of the analysis, although it may seem high, is invariably but a fraction of the price of the damage resulting to personnel and equipment and the delay that even a minor accident incurs.

Analytical results should be checked wherever possible by strain-gage determination in actual ground and flight operation.

One factor deserving investigation is the possibility of damage to intermediate drives for supercharger impellers and cooling fans. Damage to such drives may result from the combination of acceleration of cylinder firing impulses and the inertia of high-speed impellers. A heavy flywheel will protect the accessory drives during acceleration, but the weight needed may be disappointingly large.

Making Transmissions Automatic

FROM PAPERS* BY

O. K. KELLEY and M. S. ROSENBERGER

General Motors Corp.

A. ELLIOTT KIMBERLY

Chrysler Corp.

HAROLD NUTT and RICHARD L. SMIRL

Borg & Beck Division of Borg-Warner Corp.

(These papers will be printed in full in SAE Quarterly Transactions)

SUCCESS of an automatic transmission depends largely on how effectively the designer integrates components to achieve maximum performance with no conscious effort on the part of the driver. These authors show how control systems,

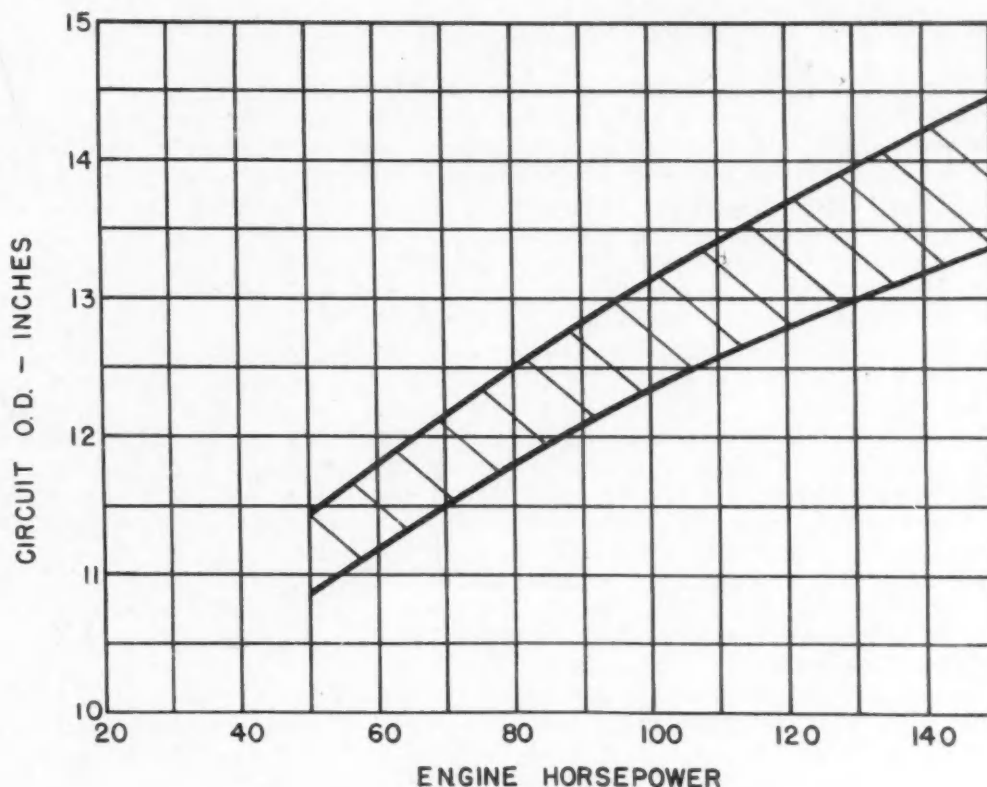
*Papers "Automatic Transmission Control Systems," by Kelley and Rosenberger, "Fluid Couplings for Passenger Cars," by Kimberly, and "Clutches for Automatic Transmissions," by Nutt and Smirl, were presented at SAE Summer Meeting, French Lick, June 3, 1947.

clutches, and fluid couplings can be tailored to the engine and vehicle to evolve a satisfactory automatic transmission.

The Hydra-Matic transmission was designed so that the driver need only hold his foot on the accelerator to the degree of performance he wants and the automatic transmission control system does the rest, according to Kelley and Rosenberger.

The control system provides sufficient hysteresis between upshifts and downshifts to eliminate shift

Fig. 1—Present-day engines will give good performance if the fluid circuit O.D. for fluid couplings partially filled with mineral oil, and required to transmit full engine torque in cruising gear, carries engine horsepower at wide-open throttle as shown. Couplings are sufficiently flexible for use on engines within a certain horsepower range.



hunting. A difference of 3 to 4 mph between the upshift and downshift at a given throttle opening is essential to prevent annoying shift recurrence — first up and then down.

Compromising maximum performance with engine noise level is even more important in downshift than in upshift. Upshift reduces engine speed so that the noise annoyance diminishes. But downshift suddenly increases engine speed and noise. It's much more noticeable than an increase in gear during acceleration. Thus passenger comfort must be preserved at some expense of maximum performance.

Kimberly sees fluid couplings playing an important part in automotive drive trains for some years to come for these reasons:

1. They eliminate manual declutching at every stop;
2. They prevent torsional vibration from reaching the drive train, lengthening its life;
3. They transmit power smoothly by cushioning the shock to the drive train from sudden throttle or clutch application and release.

Fluid coupling size for a given design depends

on factors such as power to be transmitted, operating speeds, circuit efficiency, and allowable slip at cruising speeds. For couplings partially filled with mineral oil that must transmit full engine torque in cruising gear, Fig. 1 correlates outer circuit diameters with engine horsepowers that provide acceptable performance on current engines.

For starting, Nutt and Smirl advocate the drag-free, speed-responsive friction clutch over the fluid coupling and torque converter. Both have inherent drag and necessitate a friction clutch in the drive line to disconnect the coupling or converter when shifting into and out of neutral. The centrifugal clutch can be locked after the transmission has shifted out of the starting ratio into the driving range. It improves fuel economy by eliminating slip.

The same friction clutch used by automatic transmissions for getting into and out of neutral might be employed for starting the vehicle.

These comments are incidental to the 19 clutch designs and configurations described by Nutt and Smirl that include mechanical, hydraulic, and free-wheel clutches.

HYDRAULIC STEERING

continued from page 43

The unloading valve automatically governs the pump delivery in such a manner that when the pressure of the stored oil in the accumulator drops to 800 psi, the pump recharges the accumulator to 1100 psi so that a stored volume of oil in the working pressure range of 800 to 1100 psi is always available. Whenever the pump is not charging the accumulator, it operates unloaded.

The brake system is made up of a treadle-operated hydraulic brake valve and four hydraulic cylinders designed to operate in conjunction with slack adjusters. The brake valve is fully graded from zero to maximum pressure and gives reaction at the treadle proportional to the actual braking effort at the wheel.

The hydraulic clutch actuating system employs a treadle-type valve similar to the brake valve but with no load reaction, and a cylinder similar to the brake cylinder but mounted on the clutch housing. This equipment relieves the driver of all effort in handling the clutch, except that required to compress a light spring within the valve. The system permits partial and gradual engagement of the clutch.

The hydraulic door actuating system consists of

a door engine at each door and a manual control valve for actuating the door engines separately or together. The door engines are very compact and are so proportioned that should anyone be caught in the doors, the thrust would not be injurious.

The windshield wiper system employs a single hydraulic motor for actuating the wiper blades, and a control valve which gives run and stop control and speed regulation.

Maintenance on this class of equipment is an important factor to both the manufacturer and the operator of buses and trucks. On this point, power hydraulic equipment may bring the greatest improvement. Preventive maintenance will certainly be less as there are no condensate or carboning problems with oil. Actual maintenance should also be less, judging from the record of hydraulic power equipment in industry and the performance record of the experimental coach.

Automotive engineers should not overlook the possibilities of properly engineered and applied hydraulic power equipment — its versatility, controllability, dependability, and the opportunities it offers for present and future improvements of automotive products.



Fig. 1 - Reinforced plastic automobile

PLASTIC AUTO

Features REAR ENGINE

.... No Frame

THE reinforced plastic automobile (Fig. 1) is unique in that it is structurally one piece, having no frame, rigid axles, brackets, or support. As a result, the body carries all the chassis load on builtin mounts at correct locations.

Reinforced plastic is used throughout the car, even to bumpers and wheel housings. Metal is used only for engine, drive shaft, wheels, axles, and linkage.

The car is the full width of the conventional type at the outside of the fenders - 190 in. overall. The interior is 11 ft long and 6 ft wide, taking four persons comfortably in the rear seat, with two individual, movable chairs, besides the driver's adjustable chair. Other features include thermostat heating, air conditioning, full curved glass windshields with about one-half normal size A posts at the blind spots.

Interior lighting has been designed to eliminate reflected glare from both external and internal sources, whether sunshine or headlamps.

*"Designing and Building the Reinforced Plastic Automobile," was presented at SAE Summer Meeting, French Lick, Ind., June 3, 1947.

BASED ON A PAPER* BY

LOUIS A. WERNER

ENGINEERING CONSULTANT

Wheels are independently sprung, without springs, suspension on each wheel being by means of air bellows with an expansion tank controlling frequency and softness of the ride.

The entire powerplant and drive mechanism is at the rear of the car, and the trunk, spare tire, and luggage are at the front.

Body

The body is a monocoque structure in its finished state, although about 10 major parts are mounted together to form this unit.

The plastic used is a thermosetting resin reinforced with glass fiber to give a tensile strength of 50,000-55,000 psi.

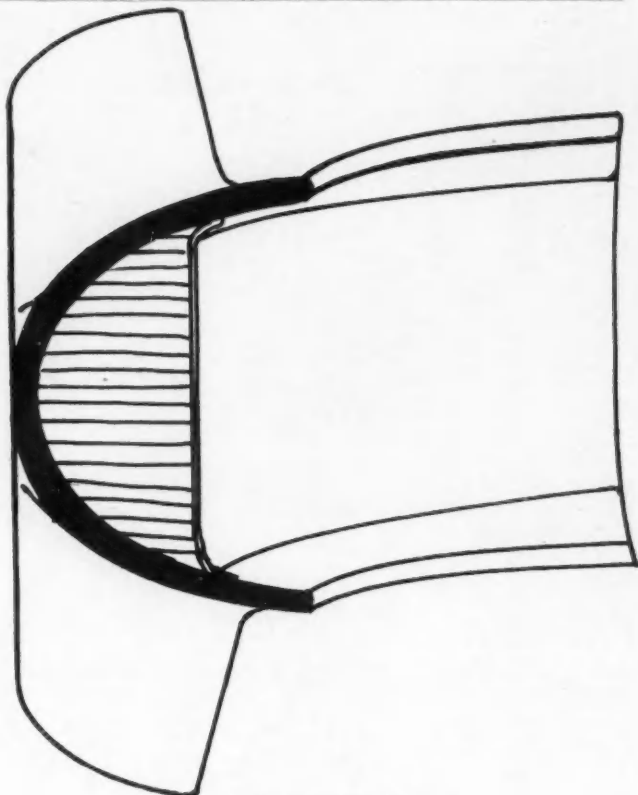


Fig. 2 - Section through bumper

This glass cloth is laid in molds, each layer being arranged in a stress direction. The whole layup is enclosed in a poly-vinyl sheet, sealed, and a vacuum pump used to extract air.

The plastic is then inserted in a large oven, the temperature brought up to the curing point and, after about four hours' time (of which about three hours and fifty minutes are used to bring up the heat in the huge mold), the resin is cured.

After allowing time to cool, to prevent any possible warpage, the part is removed from the mold and trimmed to size. It is then ready for assembly, provided no miscalculations are made and the resin was not "starved" in the construction. This condition causes delamination, making the part weak and useless.

Since the yield point of the glass is close to the ultimate, the structure is very rigid, with terrific impact resistance, so that it will take a tremendous blow without permanent set.

Six different resins are used on the entire car. Part of the structure is even made of balsa wood core, wrapped with the fiberglass fabric, and then placed in an oven to be cured.

The main portion of the floor is a honeycomb structure 2 in. thick, thinning down to as low as $\frac{1}{2}$ in. in the auxiliary portions and the center structure.

Both rear and front bumpers are made in two pieces, curved to fit the contour of the fenders and body. They are U shaped, $\frac{1}{4}$ in. thick on the outside structure, with honeycomb endwise to impact

loading, then trussed across with an additional $\frac{1}{16}$ -in. section at the middle of the U. (See Fig. 2.) Bumperettes or guards are integrally molded with the main bumper. The bumpers are mounted on the main structure by means of rubber pads and slotted supports, so as to give $\frac{1}{2}$ -in. maximum travel under 2000-lb impact loading.

The windshield post and the door pillar post, being the only vertical structural members to take the entire load between the front and rear suspension, become the main supports of the car structure, thereby skinstressing the top of the post to the body and to the side of the car. These become vertical structural members, making the car top both a tension and a compression member.

The windshield posts have to take side thrust as well as end thrust and vertical load because of their retracted angle and because the top protrudes about 12 in. forward to accommodate the curved glass windshields. The section is $1\frac{1}{4}$ in. thick and $1\frac{3}{4}$ in. wide, and is a solid fiberglass laminate above the cowl line so as to stand an end loading of probably 75,000 lb.

Windshields

Although it is possible to wipe the windshield only out to the point where the surface begins to curve, neither rain nor snow stays on the glass beyond the wiping radius.

It was found that locating the windshield and window glass at the edge of the body structure eliminates nearly all wind noise from windows. Consequently, this depth was reduced from the usual $1\frac{1}{4}$ in. average to $\frac{1}{4}$ in. with the reinforced plastic structure, as the strength is ample to carry the load and has the required rigidity to hold its shape by this narrow margin.

There is no distortion through the curved glass, and reflections and glare from sunlight, oncoming headlights, or lights within the car have been eliminated.

The glass now used is $\frac{9}{32}$ in. thick, but it is expected that safety glass of about one-half this thickness and the same strength will be available to give a considerable weight saving.

Suspension

The front suspension is unique in that the suspension arms lie parallel to the center of the car, are inclined at the predetermined caster angle of the shock and suspension strut, and the center mounting is on a $1\frac{1}{2}$ -in. honeycomb reinforced fiber construction with metal inserts between top and bottom plates. Each suspension link counteracts the other in its pull, thereby neutralizing the load at the center mount. See Fig. 3.

These suspension arms are rubber mounted at the swing center and are in line with the steering gear tie-rod ball ends. The wheel, in its up-and-down travel, does not change its steering, toe in, tread, or caster. The rubber bushing eliminates transfer of shock load to the support.

The steering is laid out to steer on both front wheels with an overall ratio of approximately 10.6:1. Our standard automobile of today has close to 18:1. The fast steering makes it ideal for a quick maneuver on the road and fast recovery.

The car can be driven off the road at high speeds, over curbs, and through chuck-holes without any tendency to "kick" the driver, without discomfort to passengers, and with excellent recovery.

Engine and Accessories

The engine and transmission are Mercury units, with the drive and arrangements as taken from Bill Stout's original Scarab design, except that the drive from clutch to transmission has been revised to a multiple V-belt of $\frac{3}{8}$ -in. section both ways.

The unit is cooled by taking air through a false window at the back and expelling it from the rear grille over the engine and then through the radiator. This method increases the normal running temperature 10-12 deg, against a conventional method of cooling in a radiator only, as the air passing over the engine partially cools the block, manifolds, and other parts.

The exhaust system is simplified by not having any tail pipes; it has two short, flexible exhaust pipes and triple-pass mufflers. The engine, axle,

and transmission are assembled as one unit, and the entire unit is mounted in the rear of the car, facilitating entire powerplant removal by disconnecting the universal joints at the axle and removing four suspension bolts.

As the plastic from which the car is made is a dielectric, it is not possible to use ordinary light systems with the conventional ground. A 2-wire system was devised, whereby battery, generator, and starter circuits are contained in the engine compartment and, due to their short lengths, give high efficiency. All controls and instruments are electrically operated, so that there are no mechanical connections from rear to front.

The driver controls the electric door locks on the steering column support. Doors operate by pushbuttons from the outside, and the locking of either door automatically locks the other electrically. In case of emergency or a dead battery, an additional 30-deg turn of the normal key action manually trips the lock, avoiding a locked-out condition.

The light front end makes the ratio of the sprung to unsprung weight so low that special tires had to be developed. A tire and tube of a 22-lb normal installation were brought down to 14 lb.

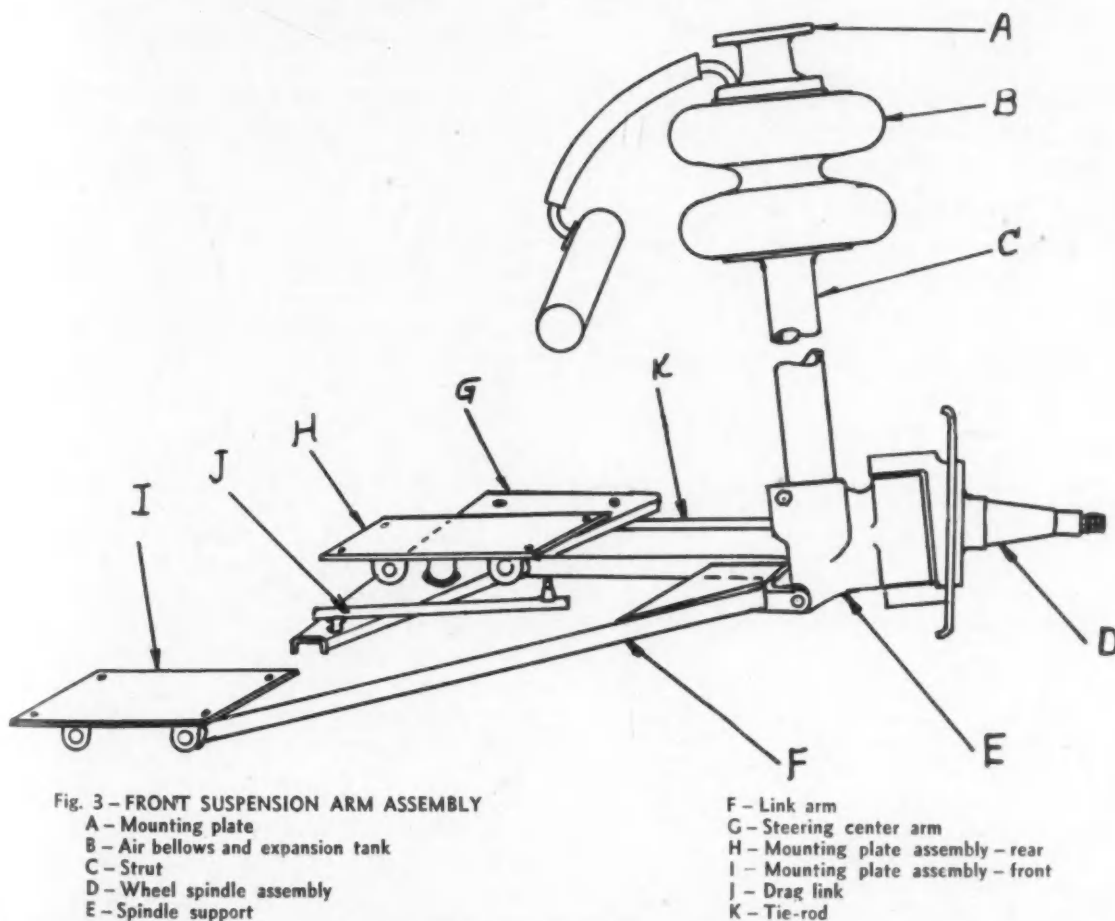


Fig. 3 - FRONT SUSPENSION ARM ASSEMBLY

- A - Mounting plate
- B - Air bellows and expansion tank
- C - Strut
- D - Wheel spindle assembly
- E - Spindle support

- F - Link arm
- G - Steering center arm
- H - Mounting plate assembly - rear
- I - Mounting plate assembly - front
- J - Drag link
- K - Tie-rod

MUCH has been written in past years on the subject of engine varnish and sludge, but never before has the subject been analyzed so thoroughly and completely as at the symposium held at French Lick last June.

Authorities now agree that engine varnish and sludge is controlled by four principal factors:

1. Fuel characteristics.
2. Lubricating oil characteristics.
3. Engine design.
4. Operating conditions (including maintenance).

Effect of Fuel

The influence of fuel characteristics was brought into focus as a result of certain military experiences in the Zone of Interior during the last war and has been followed up by investigations conducted by the Coordinating Research Council. The results of this investigation reported by W. J. Backoff showed that different fuels exhibit markedly different tendencies to cause varnish and sludge, and that differences between fuels in this respect can be determined by a laboratory engine test procedure.⁵

Up to the time of this report, however, there has been no reliable laboratory bench test for the evolu-

tion of the tendency of a gasoline to form varnish and sludge.

The factors of fuel composition that determine the tendency of a fuel to form varnish and sludge in engines are still somewhat obscure although such properties as volatility, copper-dish gum and diolefin content appear to justify further investigation.

Effect of Oil

The influence of lubricating oil characteristics on engine cleanliness has long been recognized. The use of anti-oxidants to prevent oxidation of the oil and the use of detergents to bring about a cleansing action has enabled the petroleum industry to produce improved lubricating oils which are now designated by Premium and Heavy-Duty classifications.

The colored motion pictures presented by Messrs. Burk, Van Hartesveldt, and Geniesse, describing service tests conducted by the Atlantic Refining Co., showed comparisons between certain detergent and non-detergent oils. The authors concluded that the detergent oil kept engines cleaner as shown by reduced sludge and oil ring plugging. The detergent oil also reduced rust formation under conditions favorable for rust formation with a non-detergent oil.

Field Testing

Field testing of motor oils and gasoline as carried out by Tide Water Associated Oil Co. was described by A. C. Pilger. These tests involve heavy-duty operation with gasoline engines in inter-city operation. Tests include 6,000 miles of operation followed by complete engine inspection. The schedule is reproducible and requires about 30 days for a complete test.

An example of the effect of gasoline characteristics determined in this operation is shown in Fig. 1.

Pilger concluded that engine varnish and sludge were influenced by both motor oil and gasoline. He also pointed out that maintenance of thermostats, crankcase ventilating system and gaskets

Based on Papers by

F. C. Burk Thompson Products, Inc.
and **C. H. Van Hartesveldt and J. C. Geniesse**¹ Atlantic Refining Co.

W. J. Backoff² Pure Oil Co.

A. C. Pilger, Jr.³ Tide Water Associated Oil Co.

E. J. Bowhay and E. F. Koenig⁴ Texas Co.

¹ "Effect of Lubricating Oil on Engine Cleanliness;" ² "Effect of Fuel on Engine Varnish and Sludge Deposits," report of Varnish and Sludge Group, Coordinating Research Council; ³ "Field Testing of Motor Oil and Gasoline;" ⁴ "Investigation of Factors Affecting Formation of Low Temperature Engine Deposits." Sludge Symposium presented at SAE Summer Meeting, French Lick, Ind., June 5, 1947.

The last three papers will be published in full in SAE Quarterly Transactions.

⁵ Coordinating Research Council, Designation FL-2.

SLUDGE-

Summary of a Symposium

on

Engine Deposit Studies

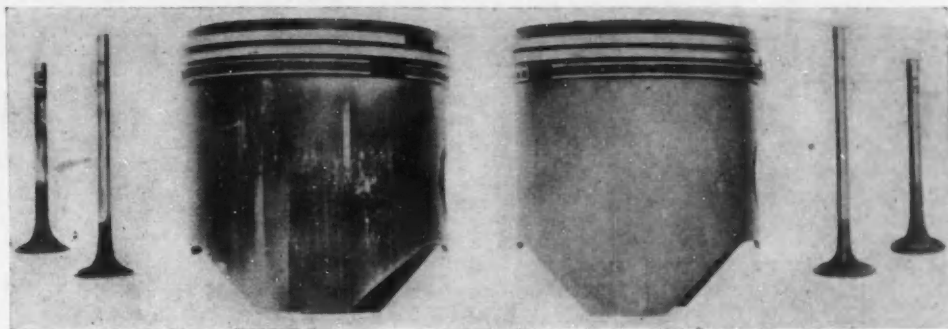


Fig. 1 - Effect of gasoline characteristics on engine deposits. Left: Gasoline A; right: Gasoline B

are important in this service. Malfunctioning of these parts may cause heavy sludge deposits that obscure the influence of either oil or gasoline.

The particular non-additive, high viscosity index motor oils tested did not oxidize sufficiently in this type of service to cause appreciable engine deposits. Consequently inhibitors and detergents did not improve engine cleanliness although they were effective in providing copper-lead bearing corrosion.

In addition motor oils were found to vary in their ability to suppress varnish and sludge deposits originating from the gasoline. The ability of an oil to suppress deposits caused by gasoline did not appear to be related to oxidation resistance, detergency or A. P. I. classification (Regular, Premium and Heavy Duty). The lighter viscosity grades of a given type of oil allowed more deposits to form than the corresponding oils in higher viscosity grades.

Reducing the interval between oil drain periods effectively reduced varnish and sludge deposits and marked changes in oil ring plugging, piston ring sticking and oil screen plugging were produced by engine design changes.

Effect of Operating Conditions

The tests described by Bowhay and Koenig of the Texas Company covered City Bus Operation, Light Delivery Truck Operation and Passenger Car Service. The program included an investigation of the influence of fuels, lubricating oils, operating conditions including maintenance, and engine design. These authors conclude that engine deposits can be reduced to a minimum by observance of the following practices:

1. Use of best available fuels. Even though a truly perfect fuel may not be available commercially, the passenger car and fleet operator may

rest assured that present fuels, in general, are the best available consistent with cost and production facilities.

2. Use of additive oils for best overall performance although additive oils, by themselves, do not comprise a complete solution to the low temperature sludge problem.

3. Maintain jacket temperature 160 to 180 F. at all times.

4. Maintain crankcase oil in vicinity of 180 F.

5. Intake mixture temperature should be maintained at the highest value possible consistent with freedom from induction system deposits, loss of power and detonation.

6. Change oil as frequently as possible consistent with allowable costs, maintenance schedules and operating conditions.

7. Use of oil filter with frequent element change.

8. Keep crankcase ventilation system free from obstructions by frequent inspection and cleaning and keep warm as possible to avoid stoppage due to freezing.

9. Keep carburetor and air filter in good condition with adjustments conforming to best practice.

10. Idle as little as possible, since even under the most favorable conditions considerable oil contamination occurs while the engine is idling.

From the information presented in these papers and the attending discussions, it is apparent that sludge and varnish is affected by a great many factors. However, the problem is capable of analysis upon the basis of the foregoing discussions and application of these principles should go a long way toward the solution of sludge and varnish problems that occur in automotive equipment.

This entire symposium, including written discussions, is immediately available from SAE Special Publications Department, at 75¢ to SAE members; \$1.50 to nonmembers.

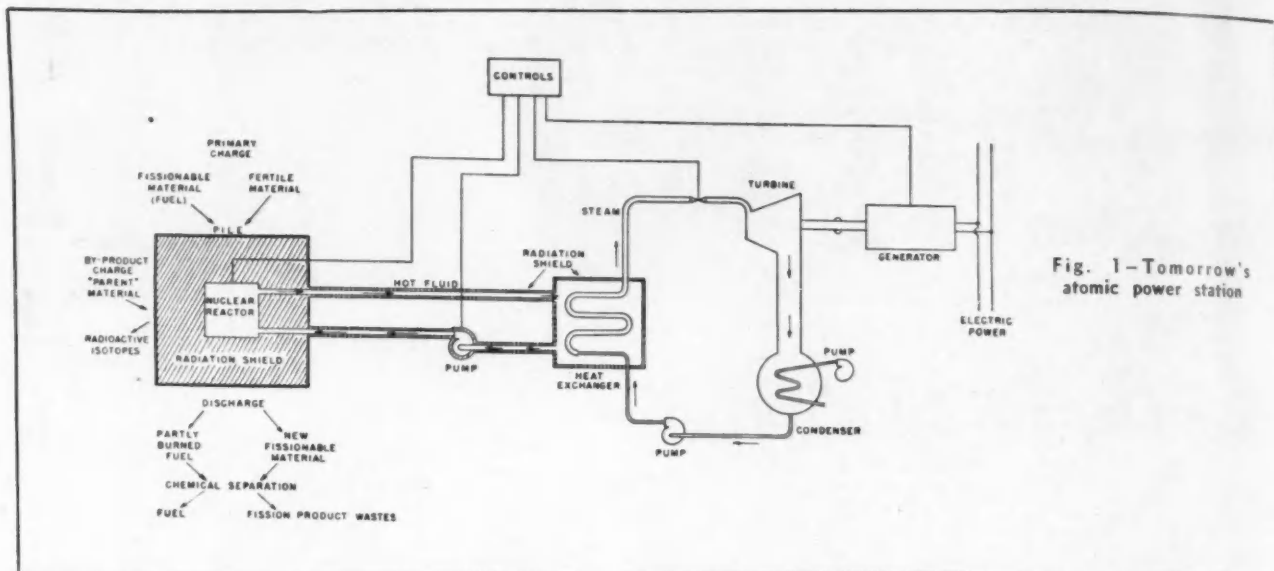


Fig. 1—Tomorrow's atomic power station

Sees Atomic Power Limited To High Output Installations

Based on paper

By H. A. WINNE

General Electric Co.

ATOMIC energy holds no promise of powering aircraft or motor vehicles in the foreseeable future, although marine and stationary powerplants loom as distinct possibilities.

Heavy protective shielding required for an atomic engine precludes its use where light weight is a factor. The shield would crush a passenger car or truck. While not feasible in terms of present-day knowledge, an atomic-powered locomotive might ultimately prove practicable.

For large commercial and naval ocean vessels atomic power appears attractive from the standpoint of requiring infrequent refueling. This may well be the first commercial application. Today atomic stationary powerplants are technically possible and will make early strides where fuel is scarce and costly.

The land-based atomic powerplant of the future might resemble the schematic in Fig. 1. Heart of the plant is the nuclear reactor which generates heat by converting mass to energy. Heat is transformed to electrical energy by being extracted from the nuclear reactor by a heat transfer fluid.

The heat transfer fluid boils water in a heat exchanger to make steam for a conventional turbine-generator.

Adequate radiation shielding must surround the nuclear reactor to protect personnel from lethal radiation.

The heat exchanger and primer heat transfer fluid will probably need a moderate amount of shielding.

The nuclear reactor is fed one of the known fissionable atomic fuels such as U235. If we wish to generate new fuel while consuming the charged fissionable material, a fertile material such as U238 may also be charged. A fertile material can be transmuted to a fissionable material by capturing neutrons.

The pile discharges both partly-burned fuel and irradiated fertile fuel which contains some new fissionable material. Subsequent use of the new and unburned fuel necessitates chemical separation from any other structural materials, containers and fission waste products.

Since atomic fission will supply heat for steam or gas generation, the system from the steam supply pipe to the consumer will be similar to present systems using coal or oil. But the nuclear reactor and heat exchanger will replace the boiler. Functionally similar components to present fuel and ash transportation, storage, preparations and disposal installations will be involved.

Depleted fuel will be reprocessed by remote control in a fuel reclamation plant. Possibility here of diverting atomic fuel would require operation by international authority.

Investment and operating costs of atomic power station from the turbine steam pipe to the consumer will be similar to those of coal or oil-fired stations. The nuclear reactor and heat

exchanger will probably involve a somewhat higher first cost than a boiler installation.

Probably the atomic plant's opportunity for reducing power costs to the consumer lies only in the cost of fuel. Atomic power can affect about 20% of the consumer's total power costs, that being the cost of fuel in modern public utilities.

Economically competitive atomic power is a long-term project. Its advent will be gradual, supplementing, but not supplanting, present power sources. (Paper, "Application of Nuclear Energy to Power Generation," was presented at SAE Cleveland Section, May 12, 1947.)

Equations Define Disc Deflections

Digest of paper

By ROY KROUSE

Fredric Flader, Inc.

(This paper, including the complete mathematical analysis, is available in multilithographed form from SAE Special Publications Department at 25¢ to members and 50¢ to nonmembers.)

DEFORMATIONS and stresses of rotating turbine wheels under the action of thrust, processional loads, and temperature gradients can be determined by the mathematical analysis outlined by Krouse. He prefaces his development of the analysis with the remarks that:

The first of the paper's three sections deals with the lateral deformation caused by the axial component of blade loading.

The second section deals with the lateral deformation of a turbine wheel which is precessing. Only in unusual

cases will the precessional velocity of a turbine wheel be sufficiently high to develop the large lateral accelerations and loads which will cause lateral deflections. The angular velocities associated with the pitch, roll, or turn of a vessel and the pullout or yaw of an aircraft are generally too low. But an aircraft spinning about a vertical axis may have an angular velocity high enough for appreciable load and deflection development. The flatter the spin, the more critical the condition.

Data on these lateral deformations caused by blade thrust and by precessional loads are useful in the design of seals to restrict the working fluid or cooling air.

The third section deals with the stresses and deformations of a rotating wheel having a temperature variation along the radius. (Paper "Stresses and Deformations of Rotating Wheels Under the Action of Temperature Gradients, Thrust, and Precessional Loads," presented at SAE Buffalo Section, Nov. 15, 1946.)

Spring Merit Rests On Fabrication Care

Based on paper

By F. P. ZIMMERLI

Barnes-Gibson-Raymond Division
Associated Spring Corp.

(This paper will be published in full in SAE Quarterly Transactions)

SPRING-MAKING technique calls for judicious material selection followed by proper fabrication and heat-treating processes that produce characteristics suited to end-product function.

Use of hardened material before processing the mechanical spring is best practice wherever possible. With steel, this practice eliminates all possibility of hardening cracks in the finished product because they are not formed in continuous hardening. If they were, they would probably open during the forming process.

Forming from hardened sections of ferrous or nonferrous materials makes it easier to find possible laps and seams.

Another reason for using this process is that recoil of forming tools will show nonuniform temper so that metallurgically-dissimilar parts can be easily detected. This is particularly important for springs vital to functioning of large parts, such as engine valve springs.

Where spring-temper material cannot be used, soft materials must be resorted to. Nonferrous metals are quenched soft and merely reheated; but steel must be hardened and drawn. In performing this operation, it has been shown that:

1. Austempered springs do not have the stress range of springs either quenched in oil and drawn back or martempered.

2. Martempered springs and those made by conventional quench-and-draw have the same stress range.

3. A martempered spring is distorted less in heat-treatment than one treated by the usual quench and draw process. Austempered springs warp even less.

4. Ductility of both austempered and

martempered spring steel is greater than that resulting from the quench-at-room-temperature and draw-to-hardness-desired method.

In addition to such generalities, choice of material for mechanical, hot-formed, and cushion springs depends on such factors as tensile strength, thickness, heat-treat properties, and fatigue life. (Paper "Proper Use of Spring Materials," was presented at SAE Summer Meeting, French Lick, June 2, 1947.)

Vehicle Paint Job Success Keyed to Surface Treatment

Digest of Paper

By VAN M. DARSEY

Parker Rust-Proof Co.

CLEANING and chemically coating steel, aluminum, and zinc truck and bus parts inhibits corrosion and insures durable paint finishes.

Prepainting preparations of metallic surfaces, which fall into three groups

depending on the degree of paint life expectancy desired, are as follows:

1. Removing contaminants such as grease, dirt, alkali, acids, and salts without changing surface characteristics. Presence of such foreign matter under a paint coat will hasten its failure.

2. Chemically or mechanically altering the metal's surface characteristics

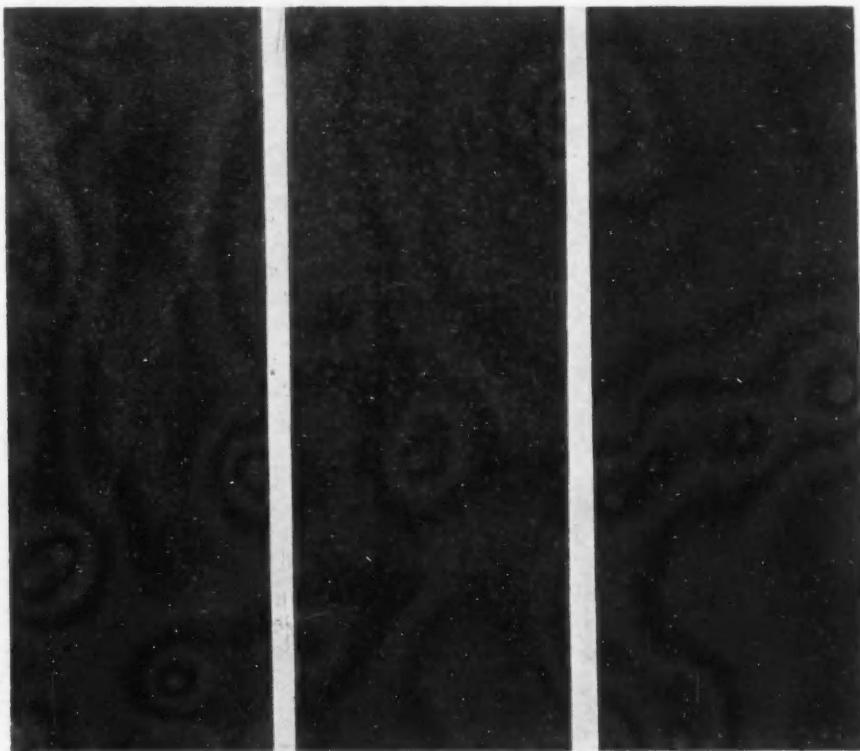


Fig. 1 - That surface conditioning prior to painting determines paint durability is evidenced by these enameled steel panels exposed to six years of outdoor weathering. The panel to the left was solvent-cleaned, the center one sand blasted, and the one on the right Bonderized. The scratch was purposely made through the paint coating at the start of the test

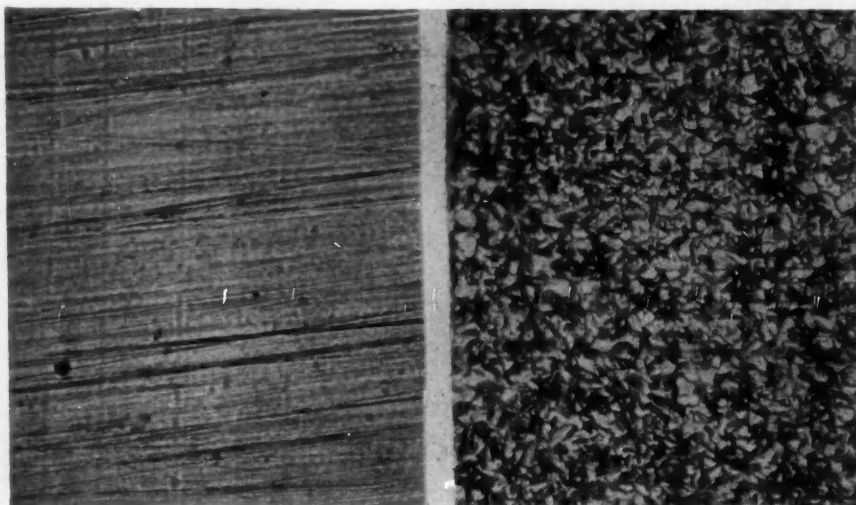


Fig. 2—These photomicrographs of 24ST aluminum surface, magnified 100 times, show the untreated surface at left and the corrosion-inhibited phosphate-coated surface at right

by sand and shot blasting and acid pickling. While providing better paint adhesion, these methods do not inhibit corrosion.

3. Converting metallic surfaces to more stable nonmetallic coatings such as phosphate inhibits corrosion, increases adhesion, and lengthens paint life.

Fig. 1 demonstrates the influence of each of these three types of treatment on the condition of painted steel panels after six years of outdoor exposure.

The difference between metal cleaning with phosphoric acid and conventional methods followed by a treatment of dilute acid - phosphate solution is worthy of explanation. Phosphoric acid cleaners remove rust and soil and etch the surface. The second method converts the surface to an insoluble crystalline phosphate coating that resists corrosion.

Tests made on steel cleaned with phosphoric acid showed a phosphate coating of only 5 to 10 mg per sq ft of surface as against a 100 to 400-mg

coating left by the phosphate coating solution (Bonderizing).

Treating Aluminum

A recently-developed method of preparing aluminum for painting consists of reacting the surface to an acid-phosphate solution containing oxidizing agents and a complex fluoride to accelerate coating formation. This converts the surface to a fine crystalline-phosphate coating that's corrosive-resistant.

Fig. 2 shows what the phosphate coating does to the surface of 24ST aluminum alloy.

Zinc alloys present difficult adhesion problems because they react with many paint finishes. Various chemical treatments can overcome this condition . . . chromate treatment, Bonderizing, phosphoric acid etch, and weathering prior to painting.

Zinc can be phosphate-coated in from 2 sec to 2 min. The coating is insoluble in water. Chromate treatments are applied by dipping. They



Fig. 3—Six years of outdoor exposure left the paint coat flaked on the conventionally-cleaned surface of the zinc die casting at left; Bonderizing the surface of the casting on the right retained the paint job through the six-year period with no signs of enamel breakdown

produce a golden-brown protective film and occasionally serve as a base for paint.

Effect of phosphate coating on paint life is shown in Fig. 3. (Paper "Metal Treatments Prior to Painting" was presented at SAE National Transportation Meeting, Chicago, April 16, 1947.)

Warns Designers Auto Market Changes

Digest of paper

By DR. FRANKLIN R. CAWL

Kudner Agency, Inc.

CHANGE seems to be the order of the day . . . for instance, people have shifted more in the last few years than at any time in our history. Economic changes have taken place which have changed our ideas of markets and even of marketing.

Industry is decentralizing—department stores branching to our suburbs and supermarkets changing our food-buying habits.

Every one of the above changes has transportation implications, and the trends that are being created are affecting, and will continue to affect, automotive design.

It depends on your thinking whether you capture the spirit of the times and translate it into automotive designs that will meet the demands of the new era . . . or whether someone else does.

Your position in the transportation field developed very rapidly after utility reached a satisfactory point. This development was relatively easy since your only competition was the decadent railroads. Today you have a new and aggressive competitor—the airplane, and a definitely revitalized railroad industry: and both of them are out to take leadership in transportation.

Two outside factors that you must watch if you are to retain transportation leadership are (1) roads and (2) terminal facilities. If these do not advance satisfactorily the design and development of your product will be slowed up.

The public desires of any period for your products have been molded by advertising in accordance with previously discovered automotive advances. If you will make the improvements we will continue to create acceptance for the new because today the public is more ready for the new and the improved in everything than at almost any other time—and they are expecting it in automobiles. (Paper "Trends Affecting Automotive Design," presented at SAE Detroit Section, May 19, 1947.)

What Will Influence AUTOMOBILE STYLING?

ART

Says **KENNETH A. HOPKINS**

George W. Walker Organization

WHEN automobiles are again plentiful, people will buy new cars not so much because the old ones are worn out or because the new cars are more efficient, but because the new cars are more attractive in appearance.

All of our automobiles have reached the stage where their efficiencies are good. The slight improvements in efficiency which appear from time to time have little appeal to the customer. When the choice rests between two automobiles of approximately equal efficiency and utility, the vehicle the customer considers to be better looking is the one he buys. Therefore, beauty with no sacrifice in efficiency is the goal of the industrial designer working on automobiles.

Sales Depend on New Designs

Behind all of the engineering and style changes is the desire to sell. It is smarter line, new and more functional design, better color, more luxurious upholstery, and more tasteful arrangement that makes people trade in an old car in good running condition to buy a new car.

Some engineers feel that the application of design and color to automobiles has been carried to extravagant lengths. Let those people remember the automobile as it was when it was built from a wholly functional conception of transportation. At that stage, the automobile was ugly.

Industrial design aims to satisfy the craving for beauty that every one of us has. Each new product is crude at its beginning. It is designed and redesigned until good style is added to utility. Only then does the product find the popularity which brings it to its maximum utility. Good design has played an especially important part in the popularity of the automobile. (Paper, "Automobile Design for the Future Is an Art," presented at the SAE Summer Meeting on June 2, 1947.)



Fig. 1 - Modellers working on preliminary quarter-scale sketch

SCIENCE

Says **VIRGIL M. EXNER**

Studebaker Corp.

AUTOMOBILE design in the future will be influenced by science rather than by art, and by costs of materials and labor, developments in powerplants, and regard for riding comfort and safety.

The designs of the Sunday-supplement stylists may be artistic, but the automobile is too complicated a product to be designed from a purely artistic approach rather than a scientific approach.

Did the stylist of the car with the top made of transparent material ever determine whether a driver could survive under such a roof on a summer day? Did the stylist who thought that aluminum and magnesium would soon replace steel in making car bodies find out the cost of these metals as compared with that of steel? Did he explain how they could be economically fabricated, welded, and maintained? Did he make sure that the new al-

loys would adapt themselves to repairs?

Design of automobiles, like airplanes, will be dictated by scientific experiment. Better streamlining will be developed to cut down drag and to eliminate wind noises. Projecting units will be eliminated or absorbed into the general body contour. Bodies will be lowered, and visibility greater.

Excess Trim to Disappear

Before the war, useless gadgets, chrome trimming, and "gingerbread" were lavished on automobiles for the sake of appearance. Now the trend appears to be toward taking things off rather than putting them on.

The resulting automobile will have the beauty inherent in clean, functional design.

Using the scientific approach, money-saving information on possible production difficulties with new designs can be gathered from experimentation with models and mockups. Fig. 1 shows modellers at work on a preliminary quarter-scale clay sketch.

Lighter engines will give designers much greater freedom in shifting engine location. But exterior styling

need not necessarily be influenced greatly by putting the engine in the rear.

Many designs which look good on paper are discarded because they are uncomfortable for passengers. It may be discovered that too little headroom

has been allowed or that the area for rear-seat passengers is too limited. Passenger comfort and safety are of the highest importance. (Paper, "What Is Automobile Design for the Future - A Science?" presented at the SAE Summer Meeting, June 2, 1947.)

Reclamation Work Cuts Repair Cost

Digest of paper

By WILLIAM W. KUNZ

International Railway Co.

A MAINTENANCE engineer in charge of a fleet of 685 buses—96% of which are put into service daily and complete their assignment without mechanical breakdown of any sort—tells what his maintenance system is.

Maintenance considerations begin with the selection of the vehicles. Buses designed so that the mechanic has good access save money on inspection and repair. Uniformity of equipment results in economical maintenance because the spare-parts inventory is minimized.

Important in the preventive maintenance program are the inspections used: a biweekly tire inspection, 2000-mile grease inspection, 3000-mile ignition and running-gear inspection, 10,000-mile engine and power inspection, 20,000-mile chassis inspection, and a 40,000-mile unit-change inspection.

Cost Studies Show Savings

Intensive reclamation work has reduced overhaul and repair expenses markedly for this fleet. They use welding, metal spraying, plating, and sleeving. Each operation is studied first to make sure that the service rendered per dollar expended for the reclaimed part is greater than that for a new part.

Gas and electric hot welding is used on steel, cast-iron, and aluminum parts such as valves, rear-axle housings, crankcases, transmission cases, shift levers, and fan pulleys. Valves reclaimed at a cost of \$0.60 last as long as new ones costing \$1.20.

Heat cracks in blocks and heads at regions which are not subject to great stress are filled mechanically by means of cold welding. This is a fairly easy job costing about \$4.85 on a head that would cost \$29.11 new.

Metal spraying is used on clutch throwout sleeves, steering knuckles, wheel bearing fits, and universal-joint oil-seal fits. It works well on shafts

and sleeves not subject to running shock loads.

Electroplating is used on surfaces requiring press fits such as universal joint parts and valve guides and shafts. A universal-joint flange can be reclaimed for \$0.75 where a new one would cost \$4.00.

Answers to an SAE questionnaire on the advisability of sleeving brake drums suggested that it could not be done satisfactorily. However, this company has been sleeving brake drums, as well as many other parts, for years. The results have been excellent. One particular brake drum was reclaimed for \$15.30. A new brake drum would have cost \$23.00. (Paper "Keep 'Em Rolling!" presented at SAE Buffalo Section, April 18, 1947.)

Fuel Injection Benefits Low-Hp Aircraft Engine

Digest of paper

By G. M. LANGE

Ex-Cell-O Corp.

(This paper will be published in full in SAE Quarterly Transactions)

DESCRIBED in this paper is an intake metering injection suitable for low-horsepower aircraft engines.

Gasoline injection is said to have many advantages over carburetion for this class of engines, such as:

1. Complete elimination of manifold icing—one of the most troublesome problems in light engines equipped with carburetors.
2. Better idling characteristics.
3. Faster engine acceleration.
4. Lower maximum cylinder-head temperatures.
5. Better fuel economy.
6. Higher power.
7. Longer periods between overhauls.
8. Simplified engine cooling.
9. Flatter engine designs are possible.

(Paper "Fuel Injection versus Carburetion for Personal Airplane Engines," was presented at the SAE National Personal Aircraft Meeting, Wichita, May 1, 1947.)

Good Design Reduces Thermocouple Errors

Digest of paper

By S. J. MARKOWSKI

and

E. M. MOFFATT

Pratt & Whitney Aircraft Division,
United Aircraft Corp.

MEANS of accurately measuring fluid flow conditions, especially temperature, have been very carefully studied during the past few years since the aircraft industry has found that better instrumentation during development testing pays off in better design of powerplant components.

Temperature measuring devices have received a large proportion of the attention because they can determine total energy, conductivity, viscosity, specific heat, and the velocity of sound.

Thermocouples, with their unique adaptability to precision measurement, are the most useful of the temperature-measuring devices. They measure a temperature somewhere between the total and static temperatures. The deviation between the total and indicated temperatures is due primarily to gas-velocity, radiation, and conduction effects.


Velocity error can be reduced by shrouding the thermocouple wire so that the wire lies in a stagnation zone. The error increases with the square of the velocity, being negligible at velocities below 250 fps at low temperatures. At high temperatures, velocity errors are unimportant even at high velocities because radiation errors are so large.

The actual radiation error, caused by radiant heat transfer between the thermocouple and surrounding surfaces which are at different temperatures, is difficult to determine, but the maximum possible radiation error can be calculated from an equation developed by the authors.

Conduction errors can be reduced to negligible values by increasing the element immersion length. Increasing velocity, using a hollow tube instead of a solid cylinder, and employing materials with low conductivity are all beneficial. Conduction error increases with increasing temperature because of the decreasing conductivity of the probe metal.

A number of thermocouple designs and materials is available. The best thermocouple for a particular job is the one which minimizes the overall error at the operating conditions of velocity, radiation, and conduction.

(Paper "Instrumentation for the Development of Aircraft Powerplant Components Involving Fluid Flow," presented at SAE National Aeronautic Meeting, April 9, 1947.)



TECHNICAL COMMITTEE PROGRESS

New Instrument Standards To Speed CAA Clearance

The nine recently-issued SAE Aeronautical Standards on

instruments to be referred to in CAA Technical Standard Orders complete most of the job undertaken by Committee A-4 late last year to develop industry-made specifications for streamlining CAA approval procedure.

The nine published minimum performance specifications for aircraft instruments now available are:

- AS 391 - Airspeed Indicator (Pitot Static),
- AS 392 - Altimeter, Pressure Actuated Sensitive Type,
- AS 394 - Climb Indicator, Pressure Actuated (Vertical Speed Indicator),
- AS 395 - Turn and Bank Indicator,
- AS 396 - Bank and Pitch Indicator, Stabilized Type (Gyro Horizon, Attitude Horizon),
- AS 398 - Direction Indicator, Magnetic, Non-Stabilized Type (Magnetic Compass),
- AS 399 - Direction Indicator, Magnetic, Stabilized Type (Stabilized Magnetic Compass),
- AS 400 - Smoke Detectors,
- AS 402 - Automatic Pilots.

After CAA Technical Standard Orders (TSO) incorporating these and other SAE minimum performance specifications are issued, the CAA will approve the use of instruments complying with these minimum performance requirements upon a statement of conformance supplied by the instrument manufacturer.

The CAA has advised industry that the TSO will not be retroactive when issued. A future date

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for compliance will be designated in the individual TSO.

Chairman R. L. McBrien, United Air Lines, Inc., thanked the following engineers from companies manufacturing these instruments who served as consultants to the Committee in preparing the instrument specifications: L. W. Burch, Control Products; R. E. Carbauh, The Wilcolator Co.; H. Grant and A. H. Hobelman, Walter Kidde Co.; F. B. Olcott and F. B. Allen, C-O-Two Fire Equipment Co.; W. E. Rohman and D. A. Wrigley, Thomas A. Edison Co.; E. R. Ryan, Fenwal, Inc.; N. W. Hartz, Mine Safety Appliance Co., and R. Hasking, Pratt & Whitney Aircraft.

Among the specifications still in the process of development are one for an electrically-heated airspeed tube (AS 393) and another for fire and heat detectors (AS 401). They are now being reconciled with recommendations received from industrywide coordination of the proposals, prior to submission to the Aircraft Industries Association that in turn recommends the specification to the CAA.

Consideration is also being given to an Aeronautical Recommended Practice for stall warning indicators. Chairman McBrien is studying this project to determine the feasibility of such a specification for indicators used on both personal and transport-type aircraft.

Another unfinished-business item of major import is the determination of dielectric test requirements . . . breakdown resistance of insulation in high-voltage testing. While the demand for the instrument specifications makes it advisable to issue them with general

THE recently-issued information report on automotive two-way radio—nearly two years in the making—aims to aid fleet operators by offering a tool for better utilization of vehicles and crews to reduce operating costs.

Developed by the SAE T & M Technical Committee's Subcommittee on Radio Communication Suitable for Automotive Fleet Application, the report tells the operator all pertinent information concerning installation of current radio equipment in passenger cars, trucks, and buses.

The Subcommittee considers the fruits of its labors valuable to all vehicle operators who must dispatch their equipment to destinations while away from the garage or office without wasting time or miles. Into this group fall doctors, fire departments, taxi cab operators, public utility companies, ambulances, and common carriers as well as bus and truck operators.

Future consideration by automotive

dielectric test requirements, more detailed tests, when agreed upon, will be incorporated in future revisions of the instrument specifications already published.

A new group of projects just launched by the Committee at the request of AIA includes tachometers; quantity indicators for fuel and oil; pressure indicators for fuel, oil, hydraulic fluid, and manifold; carbon monoxide indicator; and temperature indicators for free air, carburetor air, oil coolant, and cylinders.

Adapting Two-Way Radio to Simplified By

designers to accommodation of two-way radio equipment, where possible, to facilitate installation without increasing cost of the vehicle stems directly from this work. Evidence along this line already has been observed.

Subcommittee Chairman W. C. Baylis, N. Y. Power & Light Co., advises the report is so designed that the radiowise-nontechnical fleet operator can adapt both two-way radio and his vehicles to each other. It tells him what two-way radio equipment will cost per vehicle, its range, power needs, space requirements, selective calling information, safety precautions, and licensing procedure.

Reliable two-way communication between a fixed station and mobile equipment with 30-44 mc radio-equipped motor vehicles varies in range from 10 to 15 miles in urban areas under unfavorable conditions to 40 to 50 miles in open country. Under similar conditions, 152-162 mc equipment has comparable ranges of 8 to 10 miles and 25 to 35 miles.

A more recently available frequency—the 72-76 mc band—approaches the 30-44 mc range and the 150-162 mc low noise level.

What it Costs

The 30-44 mc type mobile-equipment sets cost about \$500 and the 152-162 sets about \$600. Cost of 72-76 mc equipment is somewhere between these figures. These estimates are exclusive of selective calling features, installation, or sometimes necessary substitution of vehicle electrical equipment.

Total space occupied by the various units of any one set should be less than 4500 cu in. and will weigh less than 75 lb.

Advised of the relative performance and approximate price of two-way radio equipment, the operator can find in the report generator and battery requirements both to power the radio and to operate his vehicle under the greatest electrical load.

The report gives tabulations and charts to compute the vehicle's electrical operating load. Selecting generator and batteries by the method prescribed insures a constant supply for total current requirements and satisfactory battery life expectancy.

In the second section the report

SAE Aircraft Instruments Committee



Snapped at a recent meeting in the midst of developing minimum performance specifications for aircraft instruments, Committee A-4 includes, starting with those seated from left to right: R. A. Brown, Minneapolis Honeywell Regulator Co.; O. E. Patton, Civil Aeronautics Administration; H. N. Droge, Kollsman Instrument Division, Square D Co.; Chairman R. L. McBrien, United Air Lines, Inc.; J. D. Redding, SAE Staff; E. R. Ryan, Fenwal, Inc.; and

A. E. Corloran. Standees, in the usual order, are: C. W. Russell, Republic Aviation Corp.; W. E. Rohman, Thomas A. Edison Co.; H. Grant, Walter Kidde & Co., Inc.; D. A. Wrigley, Thomas A. Edison Co.; D. L. Posner, Civil Aeronautics Administration; R. E. Carbauh, The Wilcolator Co.; and C. A. Wolf and V. E. Hagen, Eclipse-Pioneer Division, Bendix Aviation Corp. Nine instrument standards have been completed by this group and are now available.

Two-Way Radio to Vehicle

By New SAE Publication

enumerates and describes the following individual equipment items as comprising a vehicular radio-telephone installation:

1. Radio transmitter.
2. Radio receiver.
3. Antenna.
4. Control unit.
5. Cradle or other holder with telephone handset or hand-type microphone.
6. Selective signaling unit and/or loudspeaker.
7. Set of cables.

Weights and dimensions as well as recommended locations for these units currently manufactured are given. Fig. 1 suggests locations for these units in various types of vehicles.

In this section the operator is advised, for example, that the higher the antenna is mounted, the better it will radiate. But improved transmission must be compromised with the dangers of damage by antenna contact with overhead wires, trees, and garage doors. It cautions him of state clearance laws which prohibit a 7-ft antenna on top of a vehicle.

Selective calling equipment is characterized as a system-failure eliminator because it prevents any misinterpretation of the sending signal. Only the driver being signalled receives the call on his receiver. Without selective calling, the driver hears all signals and must determine if it's his number the dispatcher is calling.

Installation and operation of two-way radio can be hazardous, the report shows, if safety precautions are not taken. All units should be so designed and installed in the cab as to minimize injury to occupants in the event of accident. The lone driver is advised to pull off the highway when receiving or originating a call. And the radio equipment should be off when the gasoline tank is being filled.

Should the fleet operator desire to equip his vehicles with two-way radio, the report tells him fixed stations and their operators must be licensed and frequencies assigned. Information covering these rules and regulations is available from the Federal Communications Commission, Washington, D. C.

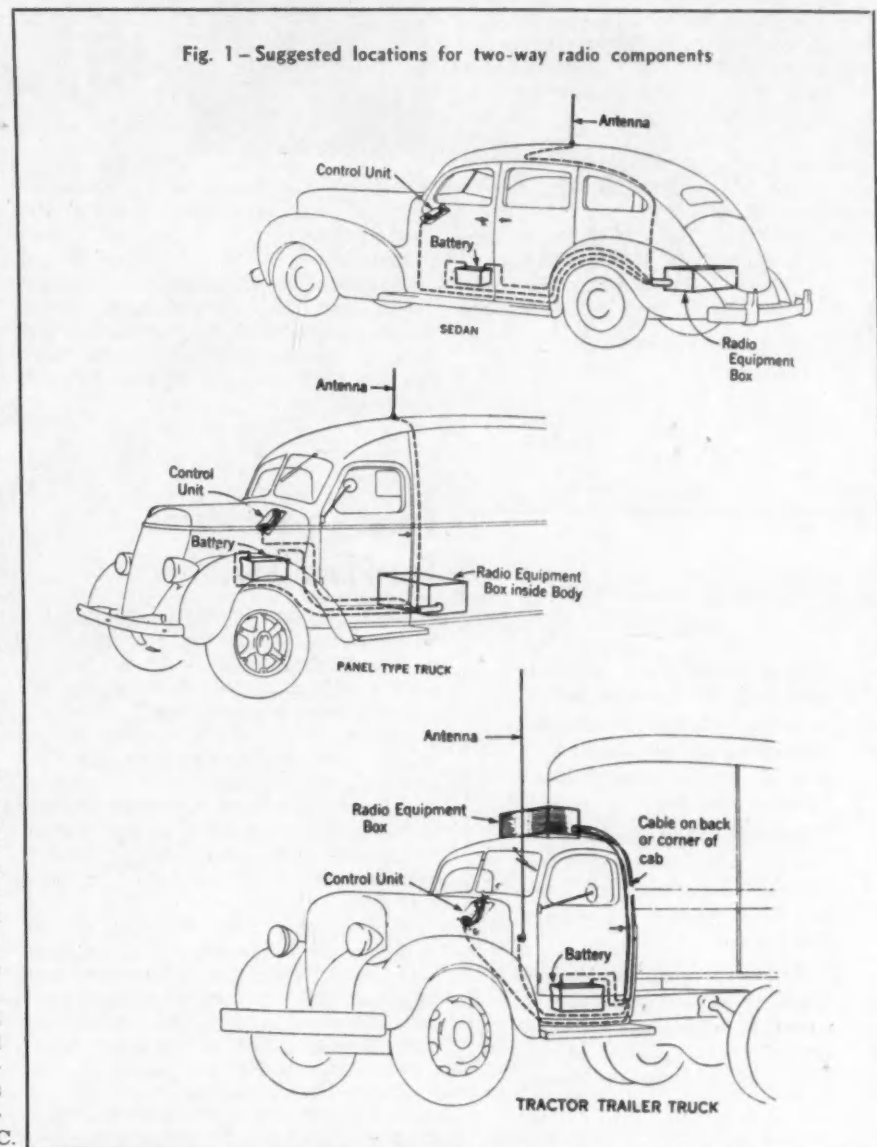
The SAE group of automotive and communications specialists that developed this treatise got underway in mid-1945. Chairman Baylis and his conferees attacked on all fronts the problem of packaging in one publication the information a fleet operator needs to install and operate automotive two-way radio.

Meetings were held with radio equipment manufacturers to find what equipment was available and how it

could be adapted to vehicles. This information was coordinated with vehicle builders to find how radio could best be installed in trucks, buses and cars. All through these meetings and consultations the Subcommittee was mindful that the communications installation must enhance, not interfere with, the vehicle's primary function.

Radio unit mock-ups were supplied by their manufacturers to experiment with different locations in vehicles pro-

Fig. 1 - Suggested locations for two-way radio components



vided by the automotive industry. By effecting a meeting of automotive and radio minds keyed to fleet operation needs in this and other ways, the group evolved a practical guide to automotive two-way radio.

The report, "Radio Communication Suitable for Automotive Fleet Application," is available through the SAE Special Publications Department for \$1.00 to members and \$2.00 to non-members.

Membership

Subcommittee membership consists of Chairman Baylis; J. H. Bolles, Delco-Remy Division, GMC; F. A. Burns, N. Y. C. Police Department; E. C. Densteadt, Detroit Police Department; Linn Edsall, Philadelphia Electric Co.; R. O. Ellerby, GMC Truck & Coach Division; R. W. Fitch, Auto-Lite Battery Corp.; F. A. Franklin, GMC Truck & Coach Division; D. F. Geisey, Studebaker Corp.; L. J. Heine, Mack Mfg. Corp.; C. C. Hudson, Tennessee Valley Authority; P. R. Kendall, Belmont Radio Corp.; J. H. Little, Chevrolet Division, GMC; C. F. Meyer, General Electric Co.; A. M. Milery, Electric Storage Battery Co.; Lloyd Morris, Galvin Mfg. Corp.; S. G. Page, Equitable Auto Co.; G. W. Pettengill, RCA Victor Division; G. M. Smith, American Tel. & Tel. Co.; R. C. Stinson, Chrysler Corp.; David Talley, International Telephone & Telegraph Corp.; C. W. Thomas, Ford Motor Co., and D. K. Wilson, New York Power & Light Corp.

SAE to Define Jet Terminology

GAS turbine engineering takes another step forward in the expansion of ARP 341A, Nomenclature Guide for Aircraft Engine Parts, by SAE Committee E-28 to include turbojet and turboprop engines as well as piston powerplants.

Objective of this recently-organized group is the definition of gas turbine terms to eliminate ambiguity and lack of uniformity prevalent in this new technology. In revising the nomenclature guide, the Committee is giving prime consideration to the turbine parts terminology submitted to SAE by the Engine Technical Committee, of the Aircraft Industries Association.



Chairman
W. C. Owens
SAE
Aircraft
Engine Parts
Nomenclature
Committee

Wherever possible, AIA's proposed definitions will be incorporated in this revision.

Committee E-28 Chairman W. G. Owens, Wright Aeronautical Corp., reports that the revised Aeronautical Recommended Practice is in the last stages of refinement before submission for the SAE Aircraft Engine Subdivision's approval.

bration testing by Dr. C. H. Havill, Eclipse-Pioneer Division, Bendix Aviation Corp. Reports from subcommittee chairmen indicated rapid progress toward the evolution of electrical equipment standards and specifications.

Plan Aero Standards As Parts Buying Aid

SAE Committee E-25 proposes to inaugurate a new series of drawings for SAE Aeronautical Standard parts for direct procurement of such parts for vendors.

Conferees at the last meeting of the Standard Parts Committee pointed out that existing Aeronautical Standards cannot be used directly as procurement documents since they do not fully cover engineering, manufacturing, and inspection requirements for procurement. The proposed AP (Aeronautical Parts) series, to include parts encompassed by the SAE standards balliwick, would fill this niche.

Chairman W. P. English, Ranger Aircraft Engines, reports a Committee recommendation that SAE parts standards be made available to the industry on vellum so that they can be reproduced in the manufacturer's plant by blueprint or ozalid methods. Admittedly more costly than present methods of issuing AS, the vellum documents were said to be invaluable time-savers.

Eliminates Delays

Frequently a manufacturer must provide suppliers or even his own shop with a number of drawings on short notice. A vellum drawing on file would eliminate any loss of time waiting for drawings of SAE standard parts.

Present Committee thinking has it that Aeronautical Standards, Aeronautical Recommended Practices, and Aeronautical Material Specifications continue to be issued on ordinary paper. The AP series, if adopted, will apply only to parts standards, referring to AS or AMS drawings for testing, materials, and process requirements. The AS series would still pertain to design standards, test specifications, and minimum performance requirement specifications.

This recommendation also entails revision of the recommended procedure for preparing SAE Aeronautical Standard drawings and specifications, for which the drafting requirements were developed by the SAE Aeronautical Drafting Manual Committee.

Committee E-25's initial task of coding SAE Aeronautical Standard parts with specific numbers to simplify procurement, stocking, and cataloguing has reached the proposal state.

Production Dinner Sept. 25

Chicago Section will cooperate with the SAE Production Activity in sponsoring a dinner for the National Machine Tool Congress on Sept. 25 at the Hotel Knickerbocker in that city.

Chairman will be Stephen Johnson, Jr., SAE vice-president for Production Engineering, and President C. E. Frudden will make a brief address.

"A Trip Through the Machine Tool Congress" will be the title of a paper to be presented by Joseph Geschelin, Detroit editor of the Chilton Co., following the dinner.

Focus on Standards For Plane Switches

SAE'S Aircraft Electrical Equipment Committee added two new subcommittees to its family of 16 to develop standards for toggle, slide-action, and personal aircraft switches.

Subcommittee A-2E, under R. A. Millermaster, Cutler-Hammer, Inc., was assigned the preparation of a proposal for lever lock-type and slide-action switches for submission to the parent committee and review of switch and airplane manufacturers and airline operators.

To determine what changes should be made in a proposed Aeronautical Standard for personal aircraft switches developed by L. Mayer, Cole-Hersee Co., Subcommittee A-2K under his chairmanship has been created.

Committee A-2's last meeting was highlighted by a discussion on environmental specifications by W. T. Harding, Air Materiel Command, and one on vi-

PROPOSED AMENDMENTS TO THE SAE CONSTITUTION

In accordance with C-57 of the Society's Constitution, the following proposed amendments to the Constitution are being submitted to the voting members of the Society.

These proposed amendments are the result of a review of the Constitution by the SAE Constitution Committee, undertaken at the request of the Advisory Committee to the SAE Council (formerly Post-War Advisory Committee) of which A. T. Colwell is Chairman. The personnel of the Constitution Committee consists of George A. Delaney, Chairman; J. H. Hunt and R. F. Steeneck. In its work the Constitution Committee had the advice of Messrs A. M. Wolf and M. C. Horine who served as consultants to the committee. The recommendations have been reviewed favorably by the past-presidents of the Society and have

been endorsed by the Advisory Committee to the Council and by the Council itself.

The explanations of the reasons for proposed amendments are quoted from the report of the Constitution Committee.

The proposed amendments were submitted, for the first time, at the Semi-Annual Business Session held at French Lick on June 4. At the Annual Meeting Business Session in January, 1948, these proposed amendments will be presented for discussion and final amendment, and will subsequently be submitted by letter ballot to all members entitled to vote, provided that 20 votes are cast at the Annual Business Session in favor of such submission.

Present Constitution

C5 The membership of the Society shall consist of Honorary Members, Members, Associates, Juniors, Departmental Members, Service Members, Foreign Members and Affiliate Members. Honorary Members, Members and Service Members are entitled to vote and to hold office. Associates, Juniors, Departmental Members, Foreign Members and Affiliate Members shall not be entitled to vote or to be officers of the Society but shall be entitled to the other privileges.

EXPLANATION: This section now covers two subjects: classification of members and the rights and privileges of the different grades of members. By eliminating the second and third sentences, the content of this section is confined to one subject—namely the classification of membership.

The amendment also eliminates Affiliate and Departmental membership classifications.

In proposing elimination of these two classes of members, the Constitution Committee concurs in a recommendation of a Special Committee on Membership Qualifications of the Advisory Committee to the Council. The proposal is based upon the belief "that the SAE primarily is an organization of individual members and that the Affiliate Members do not participate in the Society's activities except through Affiliate Member Representatives whose rights and privileges are limited."

With respect to Departmental Members, there are at present only

Proposed Amendments

C5 The membership of the Society shall consist of Honorary Members, Members, Associates, Juniors, Service Members and Foreign Members.

nine members in this grade. Because of the small use that has been made of this grade, it was felt that it might well be eliminated.

Adoption of the proposal to eliminate these two grades of membership would necessitate elimination of references to them in other sections of the Constitution.

Note: If the Affiliate Member grade is eliminated, the Advisory Committee to the Council has proposed that "Affiliate Members shall be notified of the discontinuance of this grade of membership and advised that current Affiliate Member Representatives shall be transferred to individual membership of the grade to which, in the opinion of the Council, they are entitled. There shall be no transfer fee or initiation fee."

C6 Honorary Members, Members and Service Members are entitled to vote on all questions at any meeting of the Society, in person, or by proxy given to a voting member. A proxy shall not be valid for a greater time than six months.

C6 Only Members, Service Members and Honorary Members are entitled to hold office in the parent Society; and to vote on questions arising at any Business Meeting of the Society or which may be submitted for letter ballot, and on Constitutional amendments, and for officers and Councilors of the Society, for delegates-at-large to the Annual Nominating Committee and for members of Activity Nominating Committees. Members entitled to vote may vote by proxy given to another voting member, provided that such proxy shall not be valid for a greater time than six months.

EXPLANATION: In view of the amendment to C5, it is proposed that this section be amended to define which grades of members are entitled to hold office and their voting rights.

C9 Associate grade shall be composed of persons who are engaged in the automotive and related industries in a responsible commercial or financial or manufacturing capacity, or who are so connected with the automotive and related industries as to be competent to cooperate with automotive engineers.

C9 Associate grade shall be composed of persons who are not eligible for Member grade but who are qualified, by reason of position or experience, to cooperate technically with automotive engineers in automotive engineering work or who, in the opinion of the Council, will further the objective of the Society.

EXPLANATION: This section has been the subject of study by the Advisory Committee to the Council and by the Grading Committee. The proposed new language is intended to facilitate the grading of applicants.

C11 An Affiliate Member shall be a firm or corporation engaged in the automotive or related industries, who, by the nature of its activities shall be deemed to be concerned in the object of the Society as set forth in C2. Affiliate Members shall designate and maintain at least one personal representative, and, with the approval of the Council, may designate five additional personal representatives. The qualifications of the Affiliate Member Representatives shall be at least equivalent to those for Junior, Associate or Member grade.

C11 Delete this section in its entirety.

EXPLANATION: See discussion under C5.

C12 A Departmental Member shall be a department, bureau or office of a national, state, county or municipal government interested in the object of the Society as set forth in C2. The life of a Departmental membership shall comprise a first period of ten years, with extensions of like periods, or otherwise, in the discretion of the Council. Departmental Members shall, upon notification of election, designate and maintain one personal representative.

C12 Delete this section in its entirety.

EXPLANATION: See explanation under C5.

C13 The rights and privileges of every Honorary Member, Member, Associate, Junior, Service Member and Foreign Member, shall be personal to himself and shall not be transferable by his own act or by operation of law. Departmental Membership and Affiliate Membership also shall not be transferable.

C13 The rights and privileges of every Honorary Member, Member, Associate, Junior, Service Member and Foreign Member, shall be personal to himself and shall not be transferable by his own act or by operation of law, except by the use of proxies as provided in section C6.

EXPLANATION: The reference to proxies at the end of this section has been added since the corporation law of New York establishes the right to vote by proxy.

C14 Honorary Members shall be nominated by at least ten voting members of the Society. The grounds upon which the nomination is made shall be presented to the Council in writing.

C14 Honorary Members shall be nominated by at least ten voting members of the Society. The grounds upon which the nomination is made shall be presented to the Council in writing. The election of Honorary Members shall be by a vote of the Council taken by letter ballot, as provided in the By-Laws. One dissenting vote shall defeat such election.

EXPLANATION: The sentence added to the end of this section is the same as the present section C17 which would be deleted if this proposal is adopted.

C15 All original applications for election to the grade of Member, Associate, Junior, Service Member or Foreign Member, shall be presented to the Council, which shall consider and act upon each application, electing each applicant to the grade of membership to which, in its judgment, his qualifications entitle him. Two negative votes shall defeat an election.

C15 All original applications for election to the grade of Member, Associate, Junior, Service Member or Foreign Member, shall be presented to the Council, which shall consider and act upon each application, electing each applicant to the grade of membership to which, in its judgment, his qualifications entitle him. Two negative votes shall defeat an election.

(Second and third paragraphs) Delete these paragraphs in their entirety.

All original applications for election to the grade of Affiliate Member and appointment of Affiliate Member Representative shall be presented to the Council, which shall consider and act upon each application or appointment. Two negative votes shall defeat an election or appointment.

The Council may organize a Committee of its own selection to collect the necessary information regarding applicants for membership in the Society, and to present this information to the Council in such form as the Council may specify.

EXPLANATION: With respect to the deletion of the third paragraph, as will appear later, it is proposed that a number of sections of the present Constitution requiring the appointment of specific committees be eliminated and replaced by one general section, authorizing the Council to appoint such committees as it finds necessary to carry on its work.

C17 The election of Honorary Members shall be by a vote of the Council taken by letter ballot, as provided in the By-Laws. One dissenting vote shall defeat such election.

C17 Delete this section in its entirety.

EXPLANATION: Transferred to section C14.

C18 The election of Departmental Members shall be by a majority vote of the Council.

C18 Delete this section in its entirety.

C19 Each member elected, excepting Honorary Members, shall pay initiation fee and current dues before becoming entitled to the rights and privileges of membership. Upon noncompliance with this requirement within three

C19 Each member elected, excepting Honorary Members and excepting life members elected under the provisions of C24, shall pay initiation fee and current dues, or, with the approval of the Council, installments thereof,

months after notice of election, the election becomes void.

before becoming entitled to the rights and privileges of membership. If payments are not made in accordance with these requirements within three months after notice of election, the election becomes void.

EXPLANATION: The proposed revision authorizes Council to accept initiation fees and dues of newly qualified members in installments.

C20 The Council may, at its discretion, by a three-fourths ballot vote of its duly elected members, change any then existing schedule of initiation fees for membership in the various grades. No increase in fees shall be effective until after two months' notice by publication in the JOURNAL of the Society, or by letter to the membership.

C20 The Council may, at its discretion, by a three-fourths ballot vote of its duly elected members, change any then existing schedule of initiation fees for membership. Such schedule may provide for the payment of initiation fees in installments. No increase in fees shall be effective until after two months' notice by publication in the JOURNAL of the Society or by letter to the membership.

C21 The Council may, at its discretion, by a three-fourths ballot vote of its duly elected members, change any then existing schedule of dues for membership in the various grades, and may provide for the payment of dues for periods of three, six or twelve months. No increase in dues shall be effective unless announced by publication in the JOURNAL of the Society, or by letter to the membership, at least one month prior to the beginning of the period in which the increase is to be first effective.

C21 The Council may, at its discretion, by a three-fourths ballot vote of its duly elected members, change any then existing schedule of dues for membership, and may provide for the payment of dues in installments. No increase in dues shall be effective unless announced by publication in the JOURNAL of the Society, or by letter to the membership, at least one month prior to the beginning of the period in which the increase is to be first effective.

EXPLANATION: (C20 and C21) The Committee felt that the phrase "in the various grades" might carry the implication that differentials in initiation fees and dues should be based on membership grades. It is conceivable that at some future date, it might be desirable to base such differentials on some other criterion—age, for example. The deletion is proposed to provide greater flexibility.

There seems to be no good reason for fixing the installment periods in the Constitution and hence language providing flexibility is proposed.

C22 Upon transfer of a Junior to Member, or Junior to Associate, such member shall pay the difference in initiation fee of the grades; and thereafter pay the annual dues for the grade to which he is transferred.

C22 Upon transfer of a Junior to another grade of membership, such member shall pay the difference in initiation fee of the grades; and thereafter, beginning with the next period when dues are payable, pay the annual dues for the grade to which he is transferred.

A Service Member shall upon the termination of his connection with the Service promptly notify the Secretary of such termination, shall then be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member and that specified for Service Member at the time of transfer, and thereafter, beginning with the next period for which dues are payable, shall pay the annual dues for Member grade.

A Service Member shall, on termination of his connection with the Service, promptly notify the Secretary of such termination and, if he desires to continue his membership, shall then be transferred to Member grade and, provided he has not previously paid the initiation fee for Member grade, shall pay the difference in initiation fee between that specified for Member grade and that specified for Service Member at the time of transfer and thereafter, beginning with the next period when dues are payable, shall pay the annual dues for Member grade.

A Foreign Member shall notify the Secretary upon change of residence to territory rendering him ineligible for Foreign Member grade, or temporary change of residence for more than six months in any given fiscal year, and shall thereupon be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member and that specified for Foreign Member at the time of transfer, and thereafter, beginning with the next period for which dues are payable, shall pay the annual dues for Member grade.

A Foreign Member shall notify the Secretary upon change of residence to territory rendering him ineligible for Foreign Member grade, or temporary change of residence for more than six months in any given year. If he desires to continue his membership, he shall thereupon be transferred to Member grade and provided he has not previously paid the initiation fee for Member grade, shall pay the difference in initiation fee between that specified for Member grade and that specified for Foreign Member at the time of transfer, and thereafter, beginning with the next period for which dues are payable, shall pay the annual dues for Member grade.

EXPLANATION: The amendments recognize the fact that a Service or Foreign Member may not want to continue his membership. They also provide for the cases where a Service or Foreign Member has previously held Member grade and hence paid the initiation fee for that grade.

C23 The Council may, in its discretion, permit any Member or Associate to become a Life Member in the same grade, by the payment at one time of an amount sufficient to purchase from the Equitable Life Assurance Society of New York, an annuity on the life of a person of the age of the applicant, equal to the annual dues in this grade. Such Life Member shall not be liable thereafter for annual dues.

C23 Delete this section in its entirety.

EXPLANATION: This section covers essentially a method of paying dues, and the Committee believes that the Council has adequate authority to deal with it under section C21.

C24 The Council shall have the power, by letter ballot, to admit to Life Membership, without the payment of a life membership fee, any person who, for a long term of years, has been a Member, Service Member or an Associate, when, for special reasons, such procedure would, in its judgment, promote the best interests of the Society, provided that notice of such proposed action shall have been given at a previous meeting of the Council. One dissenting vote shall defeat such admission.

C24 The Council shall have the power, by letter ballot, to admit to life membership, without the payment of a life membership fee, any person who, for a long term of years, has been a Member, Service Member, Foreign Member or an Associate, when, for special reasons, such procedure would, in its judgment, promote the best interests of the Society, provided that notice of such proposed action shall have been given at a previous meeting of the Council. One dissenting vote shall defeat such admission.

EXPLANATION: This proposed amendment would make Foreign Members eligible to life membership under this section.

C24A Past-Presidents of the Society shall be admitted to Life Membership without payment of a Life Membership fee at the end of their second year's service on the Council as Past-President.

C24A Past-Presidents of the Society shall be awarded life membership, without payment of a life membership fee, at the end of their second year's service on the Council as Past-President.

C25 Any Member, Associate, Junior, Service Member, Foreign Member or Affiliate Member who shall leave the annual dues unpaid for three months shall not receive any publications of the Society until such dues are paid. Any Member, Associate, Junior, Service Member, Foreign Member or Affiliate Member who shall leave the dues unpaid for one year shall, in the discretion of the Council, cease to have any further rights in the Society and be stricken from the rolls of membership. The resignation of a member whose account with the Society is not fully settled can be accepted only by vote of the Council.

C25 Any Member, Associate, Junior, Service Member, or Foreign Member, who is delinquent in the payment of annual dues for three months, shall not be entitled to receive any publications or other services of the Society until such dues are paid. Any Member or Service Member, who is delinquent in the payment of annual dues for three months, shall not be entitled to vote or hold office as provided in section C6, or to serve on Annual, Professional Activity or Special Nominating Committees until such dues are paid. Any Member, Associate, Junior, Service Member, or Foreign Member who shall leave dues unpaid for one year shall, in the discretion of the Council, cease to have any further rights in the Society and be stricken from the rolls of membership. The resignation of a member can be accepted only by vote of the Council.

EXPLANATION: In the main, the proposed revisions are intended to set forth more definitely the loss of rights and privileges of members who are delinquent in payment of dues. The modification in the last sentence of the section is proposed since it is the practice of the Council to act on all resignations.

C26 The Council may temporarily suspend the annual payment of dues by any Member, Associate, Junior, Service Member or Foreign Member whose circumstances have become such as to make it impossible for him to pay the dues, and may, under similar circumstances, waive the whole or part of dues in arrears. Such action shall be taken only on the written application of the Member, Associate, Junior, Service Member or Foreign Member, signed by three other members in good standing or upon the submis-

C26 The Council may temporarily suspend the payment of dues by a member of any grade whose circumstances have become such as to make it a hardship for him to pay the dues, and under similar circumstances may waive the whole or part of dues in arrears. Such action shall be taken only upon submission of evidence satisfactory to the Council that the action is for the best interests of the Society. Members whose dues have been suspended shall have Reserve Status and during the period of such suspension shall

sion of evidence satisfactory to the Council that the action is for the best interests of the Society.

not be entitled to receive the publications or other services of the Society, or to vote or hold office as provided in section C6, or to serve on Annual, Professional Activity or Special Nominating Committees.

EXPLANATION: Clarification, particularly to make it clear that a member on Reserve Status is not entitled to certain privileges of membership.

C27 Any member of any grade who in the judgment of the Council has violated the Constitution, By-Laws or Rules of the Society, or, in the opinion of the Council by a unanimous vote, has been guilty of conduct rendering such member unfit to continue in the membership of the Society, may be expelled from membership, provided, that in all such cases, the member shall have been given written notice of the charges and an opportunity to defend himself.

C27 The Council may expel any member of any grade who, in its opinion by a three-quarters vote of its duly elected members, has violated the Constitution, By-Laws or Rules of the Society or has been guilty of conduct rendering him unfit to continue in the membership of the Society; provided that in all such cases the member shall have been given written notice of the charges and an opportunity to defend himself.

EXPLANATION: The Committee felt a three-quarter vote of the duly elected members of the Council should be sufficient for expulsion.

C29 The affairs of the Society shall be managed by a board of directors chosen from among its voting members, which shall be styled the "Council." The Council shall consist of the President; the Vice-Presidents representing, one each respectively, the Professional Activities of the Society recognized by the Council on a National basis and specified in the By-Laws; six Councilors; the Treasurer; and the two surviving Past-Presidents who last held office. One-third of the number of voting members of the Council shall constitute a quorum for the transaction of business. The Secretary may take part in the deliberations of the Council, but shall not have a vote therein. The Chairmen of the Administrative and of the Technical Committees may attend the meetings of the Council and take part in the discussion of questions affecting their Committees, but shall not have a vote.

C29 The affairs of the Society shall be managed by a board of directors chosen from among its voting members, which shall be styled the "Council." The Council shall consist of the President; the Vice-Presidents representing, one each respectively, the Professional Activities of the Society recognized by the Council and specified in the By-Laws; six Councilors; the Treasurer; and the two surviving Past-Presidents who last held office. One-third of the number of voting members of the Council shall constitute a quorum for the transaction of business. The Secretary may take part in the deliberations of the Council, but shall not have a vote therein.

EXPLANATION: The deletion of the words "on a National basis" is proposed because of the Society's membership outside of the United States. As will appear later, it is proposed that the last sentence of this section be incorporated in section C45.

C30 Should a vacancy occur in the Council or in any elective office except the Presidency, through death, resignation or other cause, the Council may select a voting member of the Society to fill the vacancy until the next annual election. Should a vacancy occur in the Presidency, the Council shall select one of its number to fill the vacancy until the next annual election.

C30 Should a vacancy occur in the Council or in any elective office except the Presidency, through death, resignation or other cause, the Council may select a voting member of the Society to fill the unexpired term of the office which has become vacant. Should a vacancy occur in the Presidency, the Council shall select one of its number to fill the vacancy until the next annual election.

EXPLANATION: The present provision would be awkward to administer in the event the office of one of the Councilors-at-large serving the first year of his term became vacant after the annual letter ballot election machinery had started to function. At most, the proposed change could affect the offices of the three Councilors serving the first year of their terms.

C31 The Council shall regulate its own proceedings and may by resolution delegate specific powers to an Executive Committee or to any one or more members of the Council. No act of the Executive Committee or of a delegate shall

C31 The Council shall regulate its own proceedings and may by resolution delegate specific powers to an Executive Committee or to any one or more members of the Council; provided that no act under such delegation of power shall

be binding until it has been approved by a resolution of the Council.

be binding until it has been approved by resolution of the Council.

EXPLANATION: Clarification.

C34 The Council may, by a two-thirds vote of the members present, declare any elective office vacant, on the failure of its incumbent for six months, from inability or otherwise, to attend the Council meetings, or to perform the duties of his office, and shall thereupon appoint a voting member to fill the vacancy until the next Annual Meeting. The said appointment shall not render the appointee ineligible to election to any office.

C34 The Council may, by a two-thirds vote of the members present, declare any elective office vacant, on the failure of its incumbent for six months, from inability or otherwise, to attend the Council meetings, or to perform the duties of his office, and shall thereupon appoint a voting member to serve for the unexpired term of the office in which the vacancy occurs. The said appointment shall not render the appointee ineligible to election to any office.

EXPLANATION: For the reasons given under section C30.

C35 Each year there shall be elected from among the voting members:

A President, to hold office for one year.

As many Vice-Presidents, each to hold office for one year, as there are recognized Professional Activities of the Society, specified in the By-Laws.

Three Councilors, each to hold office for two years.

A Treasurer, to hold office for one year.

C35 Each year the following officers of the Society shall be elected from among the voting members:

A President, to hold office for one year.

As many Vice-Presidents, each to hold office for one year, as there are recognized Professional Activities of the Society specified in the By-Laws.

Three Councilors, each to hold office for two years.

A Treasurer, to hold office for one year.

EXPLANATION: The amendment is in the first clause of this section and is recommended to provide a definition of "officers" as used elsewhere in the Constitution.

C37 The term of all elective officers shall begin on the adjournment of the Annual Meeting of the Society. Officers shall continue in their respective offices until their successors shall have been elected and accepted their offices.

C37 The term of all elective officers shall begin on the adjournment of the Annual Business Meeting of the Society. Officers shall continue in their respective offices until their successors shall have been elected and accepted their offices.

EXPLANATION: To conform to change proposed in C41.

C39 The Council at its first meeting after the Annual Meeting of the Society, shall appoint a voting member to serve as Secretary of the Society for one year, subject to removal for cause by an affirmative vote of the members of the Council, at any time after one month's written notice has been given him to show cause why he should not be removed, and he has been heard in his own defense, if he so desires. The Secretary shall receive a salary which shall be fixed by the Council at the time of his appointment.

C39 The Council, at its first meeting after the Annual Meeting of the Society, shall appoint a voting member to serve as Secretary of the Society for one year, subject to removal for cause by a majority vote of the duly elected members of the Council, at any time after one month's written notice has been given him to show cause why he should not be removed, and he has been heard in his own defense, if he so desires. The Secretary shall receive a salary which shall be fixed by the Council at the time of his appointment.

EXPLANATION: The only change is the substitution of "majority" for "affirmative" in the first sentence of this section, in the interest of clarity.

C41 The Society shall hold two meetings in each year. The Annual Meeting and a Semi-Annual Meeting shall be held at such time and place as the Council may appoint. Fifty voting members shall constitute a quorum for the transaction of business.

C41 The Society shall hold an Annual Business Meeting. The Annual Business Meeting shall be held at such time and place as the Council may appoint. Fifty voting members shall constitute a quorum for the transaction of business.

EXPLANATION: This section has commonly been interpreted as referring to Business Meetings. It is believed to be desirable to make it clear that it does refer to Business Meetings rather than technical meetings. It is proposed that the mandatory requirement that a Semi-Annual Business Meeting be held be eliminated since experience has not indicated the need for such meeting every year.

C42 Special meetings of the Society may be called at any time at the discretion of the Council, or shall be called by the President upon the written request of ten per cent of the voting membership, the notices for such meeting to state the business for which they are called; and no other business shall be entertained or transacted at any such special meeting.

C42 A Special Business Meeting of the Society may be called at any time at the discretion of the Council, or shall be called by the President upon the written request of ten per cent of the voting membership, the notices for such meeting to state the business for which it is called; and no other business shall be entertained or transacted at such Special Business Meeting. Fifty voting members shall constitute a quorum for the transaction of business at Special Business Meetings.

C45 The President shall, within thirty days after taking office, appoint from the individual membership of the Society members of the following Annual Administrative Committees designating the chairmen and the vice-chairmen thereof, as indicated below:

Finance Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

Publication Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

House Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

Membership Committee; five members to be appointed by the President; the chairmen of the Membership Committees of the geographical Sections and of the Professional Activities, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and the vice-chairman of the committee for the year.

Meetings Committee; five members to be appointed by the President; the chairmen of the Meetings Committees of the Professional Activities and of the geographical Sections, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and vice-chairman of the committee for the year.

Sections Committee; three members to be appointed by the President; the other members of the Committee consisting of one member of the Society to be elected from and by each geographical Section of the Society each year prior to the Annual Meeting of the Society. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and the vice-chairman of the committee for the year.

Constitution Committee (consisting of three members); one member to be appointed by the President each year for a term of three years, the member of the Committee who shall have but one year yet to serve being the Chairman of the Committee.

EXPLANATION: The Administrative Committees covered in this section are advisory to the Council. The present provisions, particularly with respect to some of them, introduce what seems to be an unnecessary rigidity. The Committee believes that greater flexibility would be advantageous, and with this thought the proposed new section containing a general authorization to appoint committees is recommended. It is assumed that if the Constitution were so modified the Council would provide for all of these committees in the By-Laws, except the House Committee which for many years has served no useful purpose.

The last sentence in the proposed new section is transferred from C29.

C46 The Annual Nominating Committee of the Society shall consist of three delegates at large, and one delegate from each geographical section of the Society. No two of the delegates at large shall reside in the same Section dis-

C46 The Annual Nominating Committee of the Society shall consist of three delegates-at-large, and one delegate from each geographical Section of the Society. No two of the delegates-at-large shall reside in the same Section dis-

strict. The delegates at large shall be elected by the voting members present at the Business Session of the Annual Meeting. The Section delegates shall each be voting members elected by and from each Section prior to the Annual Meeting of the Society. Each Section may elect, in addition to a delegate, a first alternate and a second alternate. The first alternate shall serve in the absence of the delegate, and the second alternate shall serve in the absence of both the delegate and the first alternate. Neither a delegate nor an alternate may be represented by a proxy at a meeting of the Nominating Committee. The work and procedure of the Committee shall be as defined in the By-Laws.

strict. The delegates-at-large shall be elected by the voting members present at the Annual Business Meeting. The Section delegates shall be elected by and from each Section prior to the Annual Business Meeting of the Society. Each Section may elect, in addition to a delegate, a first alternate and a second alternate. The first alternate shall serve in the absence of the delegate, and the second alternate shall serve in the absence of both the delegate and the first alternate. All delegates and alternates to this Committee shall be voting members of the Society. Neither a delegate nor an alternate may be represented by a proxy at a meeting of the Nominating Committee. The work and procedure of the Committee shall be as defined in the By-Laws.

EXPLANATION: The present section does not require that delegates-at-large be voting members of the Society. The proposed amendment adds a requirement that all delegates and alternates be voting members.

C48 A Special professional activity may, in the discretion of the Council, be recognized by authorizing the establishing of a committee to represent the members of the Society interested in the activity, for purposes which are in harmony with the object of the Society. Such an activity so recognized shall be known as a Professional Activity; and when so recognized shall be listed in the By-Laws. It shall have such powers and act under such rules and regulations as the Council may from time to time prescribe.

Each Professional Activity so recognized shall be represented on the Council of the Society by a duly elected Vice-President, who shall be Chairman of the Committee of the Professional Activity he represents.

EXPLANATION: The amendment adds the requirement that Professional Activity Committees consist of voting members. The policy of the Council has been to limit membership on activity committees to voting members.

C48 A Special professional activity may, in the discretion of the Council, be recognized by authorizing the establishment of a committee of voting members to represent the members of the Society interested in the activity, for purposes which are in harmony with the object of the Society. Such an activity so recognized shall be known as a Professional Activity; and when so recognized shall be listed in the By-Laws. It shall have such powers and act under such rules and regulations as the Council may from time to time prescribe.

Each Professional Activity so recognized shall be represented on the Council of the Society by a duly elected Vice-President, who shall be Chairman of the Committee of the Professional Activity he represents.

New Section: C— In the inaugural year of any Professional Activity, its Vice-President shall be nominated by a Nominating Committee consisting of seven voting members, elected at a meeting of the Committee representing the Professional Activity concerned. Not more than two of the seven members elected shall be chosen from any one Section of the Society.

During each subsequent year of a Professional Activity, its Vice-President shall be nominated by a Nominating Committee consisting of seven voting members, two to be elected by the Professional Activity Committee and the remaining five elected at a stated Business Session of the Professional Activity which he is to represent. Not more than two of the seven members elected shall be chosen from any one Section of the Society.

Twenty or more members entitled to vote may constitute themselves a Special Nominating Committee of a Professional Activity, with the same power as that of the annual Nominating Committee of its Activity.

Members of Professional Activity Nominating Committees may not be represented by proxy at meetings of such committees. The work and procedure of Professional Activity Nominating Committees shall be defined in the By-Laws.

EXPLANATION: This proposed new section is verbatim from the Society's By-Laws. It is believed that since Vice-Presidents are members of the Council, the machinery for nominating them should be covered in the Constitution as is the nominating machinery for other members of the Council.

C49 The Council shall appoint annually such Standards, Research or other technical committees, or sub-committees or divisions thereof, as it may deem desirable, to investigate, consider and report upon subjects of interest to the Society. The Chairmen of such committees, and of their subdivisions, shall be designated by the President. Reports of such committees may be accepted by the Society and printed in its publications, and may be approved or adopted as the action of the Society.

C49 Delete this section in its entirety.

EXPLANATION: See explanation under C45.

C49A The Past-Presidents of the Society shall constitute the Advisory Committee. This Committee shall meet once during the Annual Meeting and at such other times and places as it may elect. This Committee shall provide for its own organization. The Committee may consider any matter referred to it by the Council, or any other matter which in its opinion concerns the interests of the Society. The Committee may report its recommendations directly to the Council, or directly to the membership of the Society when such recommendations have the approval of a majority of its full membership.

C49A The Past-Presidents of the Society shall constitute the Past-Presidents' Advisory Committee. This Committee shall meet once during the Annual Meeting and at such other times and places as it may elect. This Committee shall provide for its own organization. The Committee may consider any matter referred to it by the Council, or any other matter which in its opinion concerns the interests of the Society. The Committee may report its recommendations directly to the Council, or directly to the membership of the Society when such recommendations have the approval of a majority of its full membership.

EXPLANATION: The only change proposed in this section is that instead of being called simply the "Advisory Committee," this Committee be known as the "Past-Presidents' Advisory Committee."

C51 The Council may at any time, in its discretion, remove any or all members of any committee, except of a Nominating Committee; and the vacancy, arising from this or from any other cause, shall be filled by appointment by the President.

C51 The Council may at any time, in its discretion, remove any or all members of any committee, except of an Annual Nominating Committee, Professional Activity Nominating Committee, or Special Nominating Committee; and the vacancy, arising from this or from any other cause, shall be filled by appointment by the President.

EXPLANATION: The amendment simply makes specific reference to the different kinds of Nominating Committees.

C52 The Council may, in its discretion, authorize the organizing of geographical Sections of any or all grades of membership, for purposes which are in harmony with the object of the Society. Such Sections shall have such powers and act under such rules and regulations as the Council may from time to time prescribe. The Constitution and By-Laws of such Sections shall be in harmony with the Constitution, By-Laws and Rules of the Society and shall receive the approval of the Council before going into effect.

C52 The Council may, in its discretion, authorize the organizing of local units of the Society of any or all grades of membership, for purposes which are in harmony with the object of the Society. Such units shall be designated as SAE Sections or SAE Groups and shall have such powers and shall conform to such rules and regulations as the Council may from time to time prescribe.

The Council may further, in its discretion, authorize the enrollment, individually or by group, of persons under 30 years of age, who at the time of application, shall be bona-fide students of a recognized institution of engineering or pursuing an approved course of study in automotive engineering. Student Enrollment may be for the duration of the student's recognized or approved course plus one year thereafter but in no case for longer than five years. The Council shall determine the amount of the annual enrollment fee. Enrolled Students shall not be members of the Society, or be entitled to vote or hold office.

The Council may further, in its discretion, authorize the enrollment, individually or by group, of persons under 30 years of age, who, at the time of application, shall be bona-fide students of a recognized institution of engineering or pursuing an approved course of study in automotive engineering. Student Enrollment may be for the duration of the student's recognized or approved course plus one year thereafter. The Council may establish the maximum period for which a student may be enrolled. The Council shall determine the amount of the annual enrollment fee. Enrolled Students shall not be members of the Society.

EXPLANATION: The proposed amendments are intended to recognize the fact that the Society has two types of local units: Sections and Groups. The amendment also proposes the deletion of the last sentence of the first paragraph of this section since the preceding sentence is believed to cover the situation.

The only amendment proposed by the Constitution Committee in the

second paragraph is the deletion of the final clause "or be entitled to vote or hold office."

The Constitution Committee did not consider any change in the five-year limitation on enrollment of students. However, in its consideration of the matter the Council felt that flexibility in this limitation was desirable and it, therefore, eliminated the five-year limitation by substituting a period after the word "thereafter" in the second sentence of this paragraph and eliminating the balance of this section which reads, "but in no case for longer than five years." In its place the Council substituted the sentence, "The Council may establish the maximum period for which a student may be enrolled."

C57 At any Annual or Semi-Annual Meeting of the Society any properly authorized voting member may propose in writing an amendment to the Constitution. Any member may secure authorization to propose an amendment by securing the signatures of twenty voting members to a petition in which the proposed amendment is set forth, or by a majority vote of the Constitution Committee, or by a majority vote of the Council, which may be obtained at any regular meeting of the Council or by letter ballot at the request of the President. Such proposed amendment shall not be voted on at that meeting, but, if duly seconded by a voting member, shall be open to discussion and to such modification as may be accepted. The proposed amendment shall be mailed by the Secretary to each member of the Society entitled to vote, at least sixty days previous to the next Annual or Semi-Annual Meeting, accompanied by comment of the Council, if it so elects. At that Annual or Semi-Annual Meeting such proposed amendment shall be presented for discussion and final amendment, and shall subsequently be submitted by letter ballot to all members entitled to vote, provided that 20 votes are cast in favor of such submission. The letter ballot, accompanied by the text of the proposed amendment, shall be mailed by the Secretary to each member of the Society entitled to vote, promptly after the close of the said meeting. Thirty days after the date on which the ballots are mailed to the voting membership, the ballots returned shall be counted by Tellers appointed as provided in the By-Laws. The Tellers shall announce immediately the result of the vote which shall be mailed to the members by the Secretary. The adoption of the amendment shall be decided by a majority of the votes cast.

An amendment shall take effect immediately upon the announcement of its adoption.

EXPLANATION: The proposed amendment is recommended in part for the purposes of clarification and in part to avoid having the elimination of the Semi-Annual Business Meeting (see explanation under Section C41), unduly prolong the amendment process.

C58 For the further ordering of the affairs of the Society the Council may, by a two-thirds vote of its members present, amend the By-Laws in harmony with this Constitution, provided that written notice of such proposed amendment shall have been given at the previous regular meeting of the Council; and, provided further, that the Secretary shall have mailed to each member of the Council a copy of such proposed amendment, at least ten days in advance of the meeting of the Council at which action is to be taken. The amendment shall take effect immediately on its passage by the Council. Such amendment shall be announced in the next regular publication of the Society.

EXPLANATION: The present Constitution provides for amendments to the By-Laws but includes no specific authorization for the adoption of By-Laws.

C57 An amendment to this Constitution may be proposed by a majority vote of the Council obtained either at a Council meeting or by letter ballot of the Council taken at the request of the President, or by any voting member who secures authorization. Authorization of a voting member to propose an amendment shall consist of a petition in which the amendment is set forth bearing the signatures of twenty voting members. The proposed amendment, accompanied by any comment the Council wishes to make, shall be mailed by the Secretary to each member of the Society entitled to vote at least sixty days before the next Annual Business Meeting, or the next Special Business Meeting called for the purpose of amending the Constitution of the Society. At this Business Meeting such proposed amendment shall be presented for discussion and final amendment, and shall subsequently be submitted by letter ballot to all members entitled to vote, provided that twenty votes are cast in favor of such submission. The letter ballot, accompanied by the text of the proposed amendment, shall be mailed by the Secretary to each member entitled to vote, promptly after the close of said meeting. Ballots returned within thirty days after the date on which they are mailed to the voting membership shall be counted by Tellers appointed as provided by the By-Laws. The Tellers shall announce immediately the result of the vote, which shall be mailed to the members by the Secretary. The adoption of the amendment shall be decided by a majority of the votes cast.

An amendment shall take effect immediately upon the announcement of its adoption.

C58 For the further ordering of the affairs of the Society the Council may, by a two-thirds vote of its members present, adopt By-Laws or amend the By-Laws in harmony with this Constitution, provided that written notice of such proposed By-Law or By-Law amendment shall have been given at the previous regular meeting of the Council; and, provided further, that the Secretary shall have mailed to each member of the Council a copy of such proposed By-Law or By-Law amendment at least ten days in advance of the meeting of the Council at which action is to be taken. The By-Law or By-Law amendment shall take effect immediately on its passage by the Council. Such By-Law or By-Law amendment shall be announced in the next regular publication of the Society.



D. ROY SHOULTS was recently appointed chief engineer of the Glenn L. Martin Co., Baltimore, Md. He had been vice-president of engineering for Bell Aircraft Corp. in Niagara Falls, N. Y. Prior to joining Bell, he was with the General Electric Co., Schenectady, N. Y., for almost 20 years.



H. H. KELLY has been appointed assistant director of the Office of Transport & Communications, Department of State, Washington, D. C. From September 1945 to July of this year, Kelly served as the American representative on the European Central Inland Transport Organization. During the war he was employed in the Office of Defense Transportation.



ROBERT E. ELLIS recently joined the Marine Department of the Standard Oil Co., New York City. He will act as aviation adviser to this company's affiliates on operation of airplanes owned by them. Before this he was aviation manager for the Standard Oil Development Co., also in New York City.



R. DIXON SPEAS, who had been director of maintenance and engineering of American Airlines, Inc., freight operations, St. Joseph, Mo., has returned to his former post as assistant to the company's vice-president in charge of engineering, LaGuardia Airport, New York City. Active for a number of years in Metropolitan Section affairs, he served as its 1945-46 chairman.



JOHN E. FRAZER has been assigned to duty as CAA representative at the Glenn L. Martin Aircraft plant at Baltimore. Prior to this he was East Coast engineering representative for Trans World Airlines. He was with them from July 1945 until early this year. In the past, Frazer has been affiliated with the Ryan Corp., Lockheed Aircraft Corp. and the Adell Corp.



RICHARD M. MOCK has been elevated to the position of executive vice-president of Lear, Inc., Grand Rapids, Mich.* He has been associated with Lear since 1940 and has served as vice-president in charge of the company's Electro-Mechanical Division. Mock joined SAE in 1927.

Prior to becoming assistant manager of the Products Acceptance Department, Standard Oil Co. of Calif., San Francisco, **B. M. BERRY** was supervisor of the Engine Lubricating Oil Division, California Research Corp. in Richmond, Calif. This company is a subsidiary of the Standard Oil Co. of Calif.

Having graduated from Michigan State College, **JAMES S. STELZER** is now a draftsman with the Aeroquip Corp. in Jackson, Mich.

Formerly of Yale University, **EUGENE F. SMITH, JR.**, is now connected with Platt Brothers & Co. in Waterbury, Conn.

About

JAMES D. MOONEY, president, Willys-Overland Motors, is chairman of the United States Highway Transport Committee, a group working on world-wide simplification and unification of road signs and traffic regulations. Among those serving with Mooney on the Committee, which acts in an advisory capacity to the International Chamber of Commerce, are two other SAE members: **PYKE JOHNSON**, president, Automotive Safety Foundation, and **F. C. HORNER**, director of field operations, General Motors Corp. The committee held a special meeting in Toledo on July 22.

No longer enrolled at Rensselaer Polytechnic Institute, **ROBERT S. MARCH** is connected with the Naval Ordnance Laboratory in Washington, D. C.

SAMUEL P. KEMM has become an electrical engineer in the Barrett Division at the Allied Chemical & Dye Corp. in New York City. He had been associated with Curtiss-Wright Corp., Propeller Division, Caldwell, N. J.

EMMONS S. LOMBARD has recently been transferred from the Washington, D. C., office of the War Assets Administration, to become sales manager of machine tools in the New York zone office, New York City.

Recently appointed chief draftsman at Lewis Welding & Engineering Co. in Bedford, Ohio, **JEROLD L. WELCH** had been assistant chief engineer with the Cleveland Hobbing Machine Co., Euclid, Ohio.

Chairman of the West Coast Membership Committee in 1945, **E. VAN VECHTEN** has been appointed director of procurement and material at the Pacific Airmotive Corp. in Burbank, Calif. Prior to this, he was west coast sales manager for the Weatherhead Co. in Glendale, Calif.

J. A. SCANLAN has left the Wright Aeronautical Corp. in Wood-Ridge, N. J. He had been with Wright for the past seven years, and his plans for the future are not yet definite.



Members

A. W. LAIRD has been transferred from director of engineering, Hydraulic Division of the New York Air Brake Co., Watertown, N. Y., to the position of assistant to the president of the same company with office at 420 Lexington Ave., New York City.

Now in the employ of the Power Brake Co., Charlotte, N. C., as operations manager, **J. VAN R. KELLY** was previously a salesman for the White Motor Co. in New York City.

No longer a design engineer for McDonnell Aircraft Co., St. Louis, Mo., **LEON A. HEUSS** has become a partner in the University Plumbing & Heating Co., Columbus, Ohio.

Until recently a project engineer of pilotless aircraft, U. S. Navy Bureau of Aeronautics, Washington, D. C., **REUBEN WOLK** has now become research engineer for Reed Research, Inc., also Washington.

WILLIAM SIDNEY COWELL, who had been with the Canadian Raybestos Co., Ltd., Peterborough, Ontario, Canada, as manager of equipment sales and engineering, recently joined the "Ferodo" Division of the Atlas Asbestos Co., Ltd. in Montreal, Quebec, as manager.

HENRY FORD II, president of the Ford Motor Co., Detroit, will be speaker at the annual dinner of the American Society of Mechanical Engineers in Atlantic City on December 3.

Having served as mechanical engineer, designing high speed automatic machinery for the United States Rubber Co. at New York City for over two years, **OREST A. MEYKAR** is now managing engineer of the American Machinery & Materials Co., same city. They are engaged in experimental work, manufacturers' representation, sales and export.

Heretofore enrolled at Illinois Institute of Technology, **P. ERIC ECKBERG** is now a test engineer for the American Fort Pitt Spring Co. in McKees Rocks, Pa.

Previously affiliated with Braniff Airways at Dallas, Tex., **B. J. CUMNOCK** is now aviation engineer in the southern territory for the Texas Co., Houston, Tex.

Prior to becoming a salesman with the National Oil & Supply Co. in Newark, N. J., **RALPH NEWITTER** was southeastern district manager for the Macmillan Petroleum Corp., New York City.

BRUCE B. LATTE is now in the Engine Design Department at GMC Truck & Coach Division of the General Motors Corp., Pontiac, Mich. He was formerly enrolled at Michigan State College.

Formerly a draftsman with the Borg-Warner Corp. in Detroit, **EVAN LUCAS** has now become a body draftsman of minor layout at the Briggs Mfg. Co., same city.

A. C. BLOOMER was recently advanced to chief engineer of the Universal Corp. in Dallas, Tex. He had been chief draftsman at that company.

RAYMOND J. WOODS recently became production manager and engineer for the Rex Mfg. Co., Inc., in Gardena, Calif. Before this he was connected with the Excelo Mfg. Co. in Alhambra, Calif.

RAYMOND H. STOCKARD, who had been an instructor in mechanical engineering at Rhode Island State College, Kingston, R. I., is now assistant professor of mechanical engineering.

Until recently assistant production engineer for the W. L. Maxson Corp. in Norwich, Conn., **THOMAS A. BRAGDON** is now structural design engineer for Chance Vought Aircraft, Division of United Aircraft Corp. in Stratford, Conn.

D. M. SMITH has been appointed director of industrial sales for the McQuay-Norris Mfg. Co. in St. Louis, Mo. He has been with this company for 26 years. Prior to his new appointment, Smith was chief engineer of the Piston Ring Division, and will retain this position as chief engineer while assuming his new sales duties. He joined SAE in 1932.

RICHARD L. ZENKER, mechanical engineer, has been named to the staff of Battelle Institute, Columbus, Ohio. He will be engaged in research on combustion processes. Zenker served for three years as a design and development engineer for the Army Air Corps, prior to which he was associated with the Continental Aviation & Engineering Corp. and the Packard Motor Car Co.

Upon his graduation from the Case School of Applied Science, Cleveland, **J. GEORGE VAN OSTEROM** became a junior industrial engineer for the Cyahoga Works in Cleveland.

STUDEBAKER ENGINEERING SHIFTS



LAAS



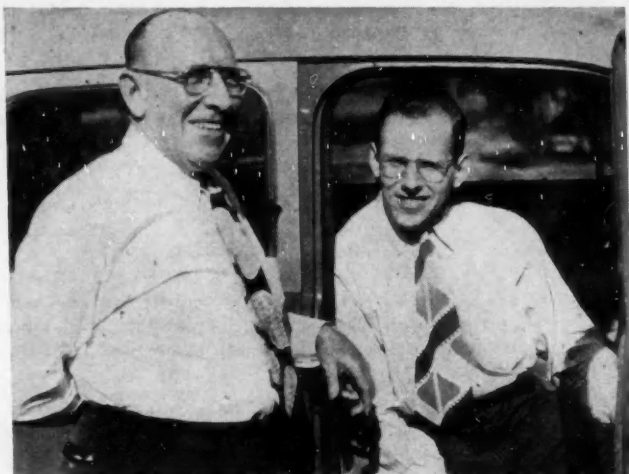
JEFFRIES



MACKENZIE

R. E. COLE, vice-president in charge of engineering at the Studebaker Corp., South Bend, Ind., has announced the following changes in the engineering department that involve both passenger car and truck posts. **A. G. LAAS**, now assistant executive engineer, will become executive engineer; **S. A. JEFFRIES**, chief truck engineer, becomes executive truck engineer, and **R. E. MACKENZIE**, special engineer, will become chief truck engineer. Studebaker's top engineering plan board, headed by Cole, will consist of **E. J. HARDIG**, chief chassis engineer; **S. W. SPARROW**, director of research; **H. E. CHURCHILL**, chief research engineer; **W. W. SMITH**, and **S. A. JEFFRIES**.

SAE Fathers and Sons



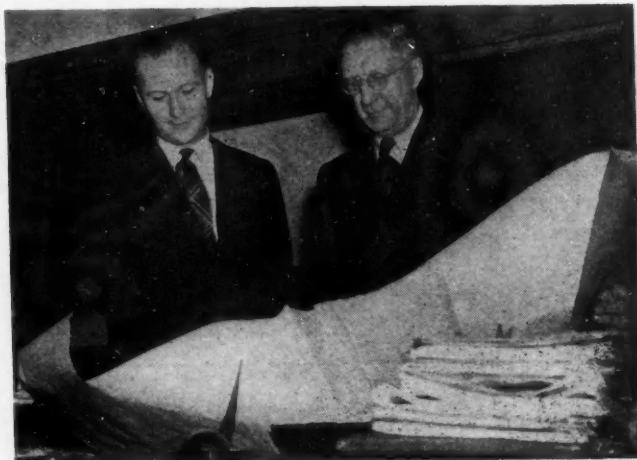
A member of the SAE since 1917, **FLOYD F. KISHLINE**, left, is chief engineer of the Nash Motors Division, Nash-Kelvinator Corp., Kenosha, Wis. His son, **FLOYD R.**, is a student at Purdue University, West Lafayette, Ind. The father was chairman of the Detroit Section in 1938 and a vice-president of the Society in 1934.

If any SAE reader knows of any SAE Father-and-Son combination, both of whom are members of the Society, your editors would appreciate hearing from you. Several SAE members have two Member-Sons.

We will write for photographs. Informal pictures of such combinations are preferred to individual formal portraits.

Your cooperation will be deeply appreciated — we don't want to miss any SAE Father and Son grouping.

ROBERT IREDELL, right, is director of engineering for the General Tire & Rubber Co. in Akron, Ohio. He has been an SAE member since 1929. His son, **ROBERT, III**, is manager of the Silentbloc Division of the above company.



ARTHUR A. BULL, left, president of the Michigan Wire Cloth Co., Detroit, and an SAE member since 1914, is pictured with his son, **ARTHUR W.** His son was recently appointed chief engineer of that company. Prior to this, he was project engineer at King Seeley Corp., Ann Arbor. He joined SAE in 1943.



Now employed as a major layout draftsman by the Chance Vought Aircraft Division of United Aircraft Corp., Stratford, Conn., **CHARLES L. WIGHT, JR.**, had been with the Glenn L. Martin Co. in Baltimore.

Previously at Oregon State College, **JOHN READ HULBERT, JR.**, is now treasurer of the Sunset Logging Co., Portland, Ore.

No longer an equipment engineer at the Shenango Penn-Mold Co. in Dover, Ohio, **DONALD BEDNEY HOOSER** has become plant engineer for the Lone Star Steel Co. in Daingerfield, Tex.

ROBERT W. BOYDSTON, who had been enrolled in Purdue University, W. Lafayette, Ind., is now an automotive engineer for the Standard Oil Co. (Ind.), Whiting, Ind.

Heretofore affiliated with the Studebaker Corp. in South Bend, Ind., **STANLEY R. BRODHEAD** recently became a special tester of commercial air conditioning and refrigeration for the Frigidaire Division of General Motors Corp., Dayton, Ohio.

JOSEPH P. BENJAMIN has become a design engineer for C. F. Braun & Co. in Alhambra, Calif. Prior to this he was chief draftsman for Ellinwood Industries, Los Angeles.

No longer enrolled at Purdue University, **THOMAS J. WALL** is a student engineer at the Chrysler Institute of Engineering, Chrysler Corp., Detroit.

ROBERT W. NIELSEN has recently become service representative for the Buick Motor Division of General Motors Corp. in Boston. Previously he had been an instructor at the General Motors Institute, Flint, Mich.

DORWARD E. WILLIS is president and chief engineer of Cathedral Corp., Tampa, Fla., manufacturers and licensors of reinforced concrete homes and industrial buildings, which can be constructed in less time and at less cost than by conventional methods.

PRESTON M. POSTLETHWAITE has been appointed manager of both the electrical and automotive divisions of the Wagner Electric Corp. branch at Portland, Ore. Prior to this he was with the sales department of the Wagner Branch at Pittsburgh. In his new post he will direct the operation of the Portland Branch and the distribution and merchandising of Wagner automotive and electrical products in that territory.

Now sales manager of the Fisk Tires Division of the United States Rubber Co., **HARRY M. RAMSAY** had been sales manager of the company's tractor and implement tire division at Detroit. His headquarters will be in New York City.

HOPE BIGGERS, who had been chief of the Aircraft Service Division of the Civil Aeronautics Administration, Fort Worth, Tex., is now chief of the Aircraft & Components Division, Department of Commerce, CAA Aeronautical center, Oklahoma City, Okla. He has been actively engaged in aviation for 21 years. Biggers served on the Membership Committee of the Mid-Continent Section in 1944.

J. E. REAGAN, right, has been elected to the presidency of the Elco Lubricant Corp. in Cleveland, Ohio, to succeed **WILLIAM COX, JR.** Cox will continue an active connection with the corporation as member of the board of directors and consultant. Reagan, who formerly was with the Timken Roller Bearing Co., Canton, Ohio, joined Elco in 1944. He will continue to serve in his former capacity of general manager.

RENE J. BENDER has become assistant to the president of the Sinclair Petroleum Co. and will leave shortly for Addis Ababa, Ethiopia, where he will represent his company. For the past 15 years, he was connected with the Sinclair Refining Co. in an engineering capacity. For 10 years, Bender was editor of the Sinclair "Firebox" in Chicago.

DAVID GORDON has been elected president of David Gordon & Co., Inc., chemical, mechanical, and industrial engineers, at 29 Broadway, New York City. They are actively engaged in handling both domestic and foreign business. Prior to this he was connected with the M. W. Kellogg Co. and the Interchemical Corp.

Prior to becoming chief of the Product Engineering Department at Western Electric Co., Inc., New York City, **A. L. VAN NEST** was a mechanical engineer for this company in Chicago.

ROBERT A. OBENBERGER recently became a partner in the Texas Motorcycle & Engineering Co., Arlington, Tex. He will be doing experimental work and development on racing motorcycles. Obenberger had been experimental engineer for the Harley Davidson Co. in Milwaukee and also served in the U. S. Army.

Having served as superintendent of maintenance at Eastern Air Lines, Inc., in Miami, **HUBERT G. LESLEY** recently was appointed vice-president of the Lessud Engineering Co. in Clayton, Ga.

R. BERTEL has been promoted from the position of plant superintendent to

that of chief automotive engineer of the Repco Ltd. interest in Melbourne, Australia.

WILLIAM E. DORSEY, JR., is now a partner in the Dorsey Construction Co. of Findlay, Ohio. Prior to this he was senior flight test engineer for the Glenn L. Martin Co. in Baltimore.

CHARLES A. CHAYNE, chief engineer of Buick Motor Division and president of the Veteran Motor Car Club of America, has announced that the 1947 Glidden Tour of antique automobiles will leave Hartford, Conn., on Sept. 18.

Prior to taking his present post as engineer of design and production for the Truck Equipment Co., Inc., Norwalk, Conn., **DONALD L. GRADER** was a transportation engineer for the White Motor Co. in Philadelphia. During the war he was a lieutenant commander in the U. S. N. R. and was chief engineer for the USS Charleston and USS Marquette.



ROBERT P. RUSSELL, formerly president of Standard Oil Development Co., central research organization for Standard Oil Co. (N. J.) has resigned to become technical consultant to International Basic Economy Corp., the Rockefeller Foundation's group for the advancement of living, health, and educational standards in Latin American countries.

No longer an aeronautical consultant for the Asiatic Petroleum Corp. in New York City, **GEORGE O. NOVILE** recently became manager of the American Republics Project at the Pacific Airmotive Corp. in Burbank, Calif.

Recently graduated from Cornell University, **HENRY M. HORN** is an engineering trainee at the Hamilton Standard Propellers, Division of United Aircraft Corp., East Hartford, Conn.

Now in the employ of Arthur G. McKee & Co., Union, N. J., as an instrument engineer **DAVID J. FRAADE** had been project assistant at Republic Aviation Corp., Farmingdale, L. I., N. Y. He was assistant editor of the Metropolitan Section's Accelerator, during 1946-1947.

JOHN McLEAN HILDT, JR., is now research associate in astro physics at the Smithsonian Institution, Washington, D. C. Prior to this he was a meteorologist for the American Overseas Airlines, LaGuardia Field, N. Y.

LEONARD E. MANNING was recently graduated from Ohio State University, Columbus, Ohio. He is employed by the Dravo Corp., Keystone Division, Neville Island, Pa., as a junior engineer.

Prior to becoming production manager of the Penokee Veneer Co. & Splicedwood Corp., Mellen, Wis., **GUS A. SEIDEL** was maintenance engineer for Trans World Airline in Kansas City, Kans.

Now a contract negotiator for Wright Aeronautical Corp. in Wood-Ridge, N. J., **GORDON V. CHRISTY** had been a sales engineer for the above company.

Recently appointed vice-president and general manager of the Truck Trailer Sales & Service Co., Pittsburgh, Pa., **OTTO WALTER** had been sales manager for the Fruehauf Trailer Co., same city.

JOSEPH E. PADGETT, formerly vice-president of the Spicer Mfg. Corp., Toledo, Ohio, is now director of manufacturing, Solar Aircraft Co., San Diego, Calif.

Piasecki Helicopter Corp. has moved into its new plant at Morton, Pa., about 10 miles southwest of Philadelphia, **FRANK N. PIASECKI**, president, announced. The \$500,000 plant of the seven-year-old company is located on a plot of 55 acres.

A second edition of "The Modern Gas Turbine" by **R. TOM SAWYER**, manager of the Research Department, American Locomotive Co., has been published by Prentice-Hall, Inc. Review questions for each chapter have been added in an appendix. The book covers the history of gas turbine development and use in industry, marine service, locomotives, and aircraft. **SAMUEL T. ROBINSON** of the Taylor Turbine Corp. and **KENNETH A. BROWNE** of the Chesapeake & Ohio Railway Co., wrote the chapter on aircraft gas turbines. A chapter on combustion gas turbine calculations and efficiencies was prepared by **RONALD B. SMITH** of the Elliott Co.

R. M. CRITCHFIELD has changed jobs at Delco-Remy Division of General Motors Corp., Anderson, Ind., now having the assignment of factory manager. He had been chief engineer, and has been active for many years on SAE electrical standards committees. He is chairman of the Electrical Equipment Committee.

PORT BRANNON is now an assistant observer at the Stanlion Oil & Gas Co. in Tulsa, Okla.

CURTIS EUGENE LUNDBLAD has now become mechanical engineer of the Fuel & Oil Branch, Power Plant Laboratory, AAF - Air Materiel Command, Wright Field, Dayton, Ohio. Previous to that post he was director of training, Army Air Forces, Nellingen, Germany.

No longer a student at the University of Oklahoma, Norman, Okla., **GLENN P. MYER** is a student engineer for the Ingersoll-Rand Co., Phillipsburg, Pa.

GEORGE E. HARRIS is now a sales representative for the Kay Sales Co. in Kansas City, Mo. He had been an agent for Braniff Airways, Inc., Dallas, Tex. He is very much interested in altitude engineering.

COL. HERBERT J. LAWES, one of the leading automotive engineers in the U. S. Army during the latter part of his long career, has retired from active service. As commanding general of the Holabird Ordnance Depot, he had been closely identified with military wheeled transport used in World War II. He served as liaison officer with SAE advisory committees on transportation and maintenance problems. He had administrative posts at Aberdeen Proving Ground between Holabird assignments.

Now serving as project engineer for the Engineering Service Co. of America, Detroit, **RAYMOND J. DARGA** had been manager of the Service Division, Commonwealth Engineering Co., Dayton, Ohio.

Recently graduated from the University of Cincinnati, **EDWARD C. GEBHART** is now employed as a student engineer at the Kingston Conley Electric Co., North Plainfield, N. J.

ROBERT L. CARTER is now an engineer with the General Electric Co. in Lynn, Mass.

No longer in the Engineering Department, Chevrolet-Cleveland Division of General Motors Corp., Detroit, **FRANK R. L. DALEY, JR.**, is affiliated with the Buick Motor Division in Flint.

O B I T U A R I E S

WILLIAM A. WAGSTAFF

William A. Wagstaff, who had been an engineer with the Naval Ordnance Laboratory in Washington, D. C., passed away on June 13.

At the time of his death, he was a mechanical engineer at the Naval Ordnance Laboratory which gave him a large responsibility in the Navy's torpedo development program. Wagstaff had occupied several important positions in industry before he moved to Washington in 1946. Among the firms with which he had been connected are the First Industrial Corp., Boston; Frigidaire Division of General Motors Corp., Dayton; Norge Division, Borg-Warner Corp., Detroit; and General Motors Research, Detroit.

He was particularly active in the Detroit section while living in that city.

WALLACE R. CAMPBELL

Wallace R. Campbell, chairman of the board of the Ford Motor Co. of Canada, died at his home in Windsor, Ontario, on August 10. His age was 65.

A former president of the company, he retired as active head in April, 1946, becoming chairman of the board of directors. He joined the company 42 years ago and was named president in March, 1929.

Shortly after he became president of the Ford Motor Co. of Canada, at the 25th anniversary celebration of the company, he stamped the number 900,000 on the cylinder block of a Ford motor, indicating it was the 900,000th to come off the Canadian assembly line. He had been a member of the SAE since 1934.

SAE National

PRODUCTION MEETING and CLINIC

Oct. 20-21

Carter Hotel, Cleveland

MONDAY, OCT. 20

2:00 p.m.

J. H. W. Conklin, Chairman

Material Handling - Conveyors - John Von Rosen, Plymouth Div., Chrysler Corp.

Pallet Loading and Shipping - W. L. Pearce and C. L. Daly, Chevrolet Motor Div., GMC

6:00 p.m.

8:00 p.m.

Buffet Supper

F. C. Pyper, Chairman

Latest Developments in Mass Production Techniques in the Automotive Industries - Joseph Geschelin, Detroit Editor, Automotive Industries

TUESDAY, OCT. 21

ALL-DAY PRODUCTION CLINIC

10 a.m.

Nine informal gatherings to exchange information and experience on vital production problems. Each group will have a panel of experts available all day to answer questions. Come early, quiz the experts, and go home with the answers.

2 p.m.

3:30 p.m.

1 CHIP and SCRAP DISPOSAL. Panel

Leader - K. R. WEISE, chief engineer, Tramrail Div., Cleveland Crane & Engineering Co. Panel members - A. J. Campau, salvage section, GMC; Howard Dreher, Fisher Body Div., GMC; C. R. Langley, by-products supervisor, Delco-Remy Div., GMC; O. L. Maag, Lubrication Engineer, Timken Roller Bearing Co.; A. R. Menerey, salvage department, Cadillac Motor Car Div., GMC; Robert Oldfield, president, Western Auto Machine Service Co.

2 FORGINGS. Panel Leader - AR-

THUR TOWNHILL, manager, Light Metals Div., Thompson Products, Inc. Panel Members - C. B. Dakin, manager, Oldsmobile Forge Plant, GMC; W. W. Dyrkacz, chief metallurgical engineer, Cameron Mfg. Co.; J. H. Friedman, vice-president, National Machinery Co.; R. I. MacArthur, superintendent, Forge Shop, Buick Motor Div., GMC; B. D. Marshall, plant manager, Chevrolet-Detroit Forge.

3 FOUNDRY. Panel Leader - A. E.

WILSON, president, Keal-Kennedy Co. Panel Members - A. H. Hinton, manager, Cleveland Sand Foundry, Aluminum Co. of America; E. C. Jeter, assistant foundry superintendent, Ford Motor Co.; W. G. Mixer, superintendent, foundry, Buick Motor Div., GMC; J. H. Redhead, president, Lake City Malleable Co.; J. H. Smith, general manager, Central Foundry Div., General Motors Corp.

4 GEARS. Panel Leader - V. C.

SPEECE, executive truck engineer, White Motor Co. Panel Members - J.

O. Almen, head mechanical engineering 1, Research Laboratories Div., GMC; Bain Griffith, resident engineer, Chevrolet Gear and Axle Div., GMC; G. H. Sanborn, chief field engineer, Fellows Gear Shaper Co.; George Slider, consulting engineer, Chrysler Corp.

5 GRINDING and CUTTING TOOLS. Panel Leader - J. R. COX,

managing partner, Balas Collet Mfg. Co. Panel Members - H. L. Curtiss, master mechanic, AC Spark Plug Div., GMC; A. Karabinus, factory manager in charge of valves, Thompson Products, Inc.; J. Pawloski, master mechanic, Detroit Diesel Engine Div., GMC; J. W. Podesta, vice-president, American Broach & Machine Co.

6 INSPECTION and QUALITY CONTROLS. Panel Leader - W. S.

HOWARD, chief inspector, White Motor Co. Panel Members - E. S. Marks, quality manager, Pratt & Whitney Aircraft, Div., United Aircraft Corp.; C. F. McElwain, superintendent, International Business Machines Corp.; J. R.

Steen, director, quality control, Sylvania Electric Products, Inc.; W. R. Toeplitz, vice-president, engineering & research, Bound Brook Oil-Less Bearing Co.; D. P. Walsh, Detroit district manager, Magnaflex Corp.; A. A. Weidman, director, quality & inspection, Detroit Diesel Engine Div., GMC.

7 METALLURGY and HEAT TREATMENT. Panel Leader - H. B. OS-

BORN, JR., sales manager, Ohio Crankshaft Co. Panel Members - W. J. Diederichs, metallurgist, Autocar Co.; H. P. Knowlton, materials engineer, International Harvester Co.; H. A. Tobey, Bearing Plant Metallurgist, Timken Roller Bearing Co.; F. C. Young, head, Metallurgical Div.; Ford Motor Co.

8 PRODUCTION CONTROL. Panel Leader - S. F. STEWART, executive

vice-president, Leece Neville Co. Panel Members - J. E. Adams, director, material control, White Motor Co.; E. J. Barney, production manager, Detroit Diesel Engine Div., GMC; C. A. Koepke, production management consultant; W. O. Nelson, director, Production Control and Purchasing, Electro-Motive Div., GMC.

9 WELDING. Panel Leader - L. C. DANIELS, chief engineer, Towmotor

Co. Panel Members - M. F. Gouran, welding engineer, Autocar Co.; H. Hankink, assistant chief, Material Laboratory, Wright Aeronautical Corp.; P. H. Setzler, United Welding Co.; J. R. Wirt, progress department, Delco-Remy Div., GMC.

6:30 p.m. DINNER Oct. 21

J. E. Hacker, General Chairman

Robert Cass, Toastmaster

C. E. Frudden, SAE President

"Getting Along with Each Other"

RALPH E. FLANDERS

U. S. Senator from Vermont

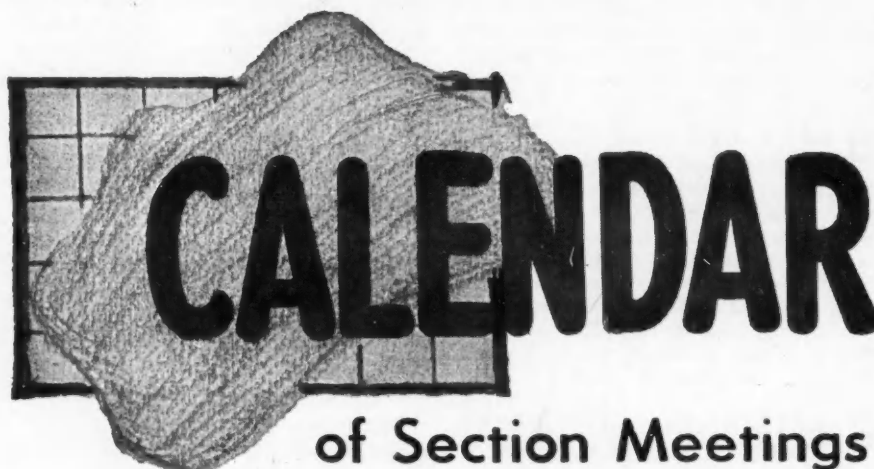
(Formerly president, Jones & Lamson Machine Co.)

SAE NATIONAL MEETINGS

MEETING	DATE	HOTEL
TRACTOR	Sept. 17-18	Schroeder Milwaukee
AERONAUTIC (Autumn)	Oct. 2-4	Biltmore Los Angeles
PRODUCTION	Oct. 20-21	Carter Cleveland
FUELS & LUBRICANTS	Nov. 6-7	The Mayo Tulsa
AIR TRANSPORT	Dec. 1-3	Continental Kansas City, Mo.
ANNUAL	Jan. 12-16 (1948)	Book-Cadillac Detroit

TRACTOR MEETING . . .

JOHN STROHM, President, Northern Illinois Publications, Inc. will speak at the
Tractor Meeting Dinner on Sept. 18
Subject: "The People Behind the Iron Curtain"



British Columbia Group - Sept. 8

Georgia Hotel, Vancouver; dinner 6:30 p.m. The Nature of Fuel Knock - C. D. Miller, Battelle Memorial Institute.

Canadian - Sept. 26

Hamilton Golf and Country Club, Ancaster; golf 12 noon, dinner 7:00 p.m. Patience on a Monument - W. J. McCulloch, director, Canadian Chamber of Commerce.

Chicago - Sept. 12 and 25

Sept. 12 - Westward Ho Golf Club; playday - golf, cards, social activities.

Sept. 25 - Knickerbocker Hotel; dinner 6:30 p.m. Joint meeting with the

American Machine Tool Builders' Association Congress. Toastmaster - Stephen Johnson, Jr., SAE vice-president, Production Activity, and assistant sales manager, Bendix Westinghouse Automotive Air Brake Co. Coffee speaker - C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co. and president, SAE. Trip through machine tool show - Joseph Geschelin, Detroit Editor, Automotive Industries.

Kansas City - Sept. 9

Brookside Hotel; dinner 6:30 p.m. Organization meeting for members only.

Milwaukee - Sept. 19

Ozaukee Country Club; Annual Golf Tournament followed by dinner.

Mohawk-Hudson Group - Sept. 20

McKown Grove, Albany; Luncheon and sports 1:00 p.m. clambake 5:00 p.m.

Peoria - Sept. 29

Jefferson Hotel, Peoria; dinner 6:30 p.m. Sleeve Bearings - Arthur Underwood, Western advertising manager, SAE Journal. Technical Chairman - G. E. Burks.

St. Louis - Sept. 9 and Oct. 14

Sunnen Products Co.; dinner 6:45 p.m. Fits and Finishes - August Sunnen, Jr. Plant inspection.

Oct. 14 - Forest Park Hotel; dinner 6:30 p.m. Fuels of the Future - T. E. Rendel, assistant manager, aviation department, Shell Oil Co.

Salt Lake Group - Sept. 19

Newhouse Hotel; meeting 8:00 p.m. The Nature of Fuel Knock - C. D. Miller, research engineer, Battelle Memorial Institute.

San Diego - Sept. 25

San Diego Woman's Club; meeting 7:30 p.m. Why Pneumatics - H. F. Gerwig, Consolidated Vultee Aircraft Corp. Motion pictures of Convair XB-46.

Southern California - Sept. 15

Rodger Young Auditorium, Los Angeles; dinner 6:30 p.m. Hi-Speed Photo Combustion Investigation - C. D. Miller, Battelle Memorial Institute. 16 mm film illustrating talk.

Southern New England - Sept. 17

Ballroom Hotel, Hartford, Conn.; dinner 7:00 p.m. Early Developments of the Automobile Industry in Hartford - Herbert W. Alden, director of engineering, Timken Detroit Axle Co. and past president, SAE. Joint meeting with veteran auto clubs for Hartford Golden Automobile Jubilee. Special tour of antique car exhibit for SAE members and guests 3:00 to 6:00 p.m.

Spokane-Intermountain - Sept. 3

Desert Hotel; dinner 6:30 p.m. meeting 8:00 p.m. The Nature of Fuel Knock - C. D. Miller, Battelle Memorial Institute.

Twin City - Sept. 4

Curtis Hotel, Minneapolis; dinner 6:00 p.m. Engineering Whys of the Modern Tractor, C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co. and president, SAE. Moving picture - Tractors at Work.

Williamsport Group - Sept. 8

Anglers Club, Williamsport; dinner 7:00 p.m. Auto Requirements Peculiar to the Fire Fighting Industry - E. D. Herrick, vice-president in charge of manufacturing, American-LaFrance-Foamite Corp.

SAE 1947 National

Aeronautic Meeting

(Fall)

Biltmore Hotel
Los Angeles

Oct. 2-3-4

THURSDAY, OCTOBER 2

10:00 A. M. **POWERPLANT**
John Young, Chairman

CAA Aircraft Fire Prevention Developments - H. L. Hansberry, Civil Aeronautics Administration

2:00 P. M. **AIRCRAFT-TRANSPORT**
C. L. Johnson, Chairman

Fuel Tanks - Integral vs. Bladders vs. Metal Cells - J. E. Lindberg, Jr., Frank Zerelli, and C. R. Ursell, Pan American Airways, Inc.

Prepared Discussion

2:00 P. M. **POWERPLANT**
W. J. Blanchard, Chairman

Future Power for the Personal Airplane - J. W. Thorp, Thorp Aircraft Co.

Reduce Airplane Noise Through Basic Design - W. E. Burnham, Beech Aircraft Corp.

Prepared Discussion

8:00 P. M. **GENERAL POWERPLANT**
Ivar Shogran, Chairman

The Allison V-1710 Exhaust Turbine Compounded Reciprocating Aircraft Engine - Dimitrius Gerdan and J. M. Wetzler, Allison Div., General Motors Corp.

Engine Compounding for Power and Efficiency - E. F. Pierce and H. W. Welsh, Wright Aeronautical Corp.

Prepared Discussion

FRIDAY, OCTOBER 3

10:00 A. M. **AIRCRAFT**
H. W. Adams, Chairman

Research on Aircraft Hydraulic Packings - T. J. McCuiston, F. E. Clark, R. A. Clark, and L. E. Cheyney, Battelle Memorial Institute

The Cause for Pneumatics for Intermittent Services on Aircraft - H. F. Schmidt and H. F. Gerwig, Consolidated Vultee Aircraft Corp.

10:00 A. M. **TRANSPORT**
Harold Hoekstra, Chairman

A New Approach to Cockpit Layout - Com. T. D. Davies, Bureau of Aeronautics, Navy Department

Prepared Discussion

2:00 P. M. **AIRCRAFT**
J. S. Marriott, Chairman

Traffic Control Requirements for Jet Transport Aircraft - W. T. Dickinson, Douglas Aircraft Co., Inc.

The Calculation of Heat Required for Wing Thermal Ice Prevention in Specified Icing Conditions - Carr Neel, Ames Laboratory, NACA

2:00 P. M. **POWERPLANT**
N. C. Price, Chairman

The Metallurgical Aspects of Gas Turbine Wheels and Nozzles - E. M. Phillips, General Electric Co.

Turbine Engine Blading: Manufacturing Techniques and Fastening Methods - A. T. Colwell and R. E. Cummings, Thompson Products, Inc.

Electronic Analog Studies for Turbo-Prop Control Systems - G. A. Philbrick, Philbrick Researches, Inc., W. T. Stark and W. C. Schaffer, Wright Aeronautical Corp.

**Banquet
and
Grand Ball**

**ON
SATURDAY
OCTOBER 4**

8:00 P. M. **GENERAL AIRCRAFT**
F. W. Fink, Chairman

Message from the Aircraft Industries Association - Capt. L. D. Webb, Western Regional Manager, AIA

Message from the Air Transport Association - T. C. Drinkwater, President Western Air Lines, Inc.

Presentation of the MANLY MEMORIAL MEDAL to C. D. MILLER by R. F. GAGG, Member, Manly Memorial Board of Award

Problems in Compressible Flows for Airplanes - John Stack, National Advisory Committee for Aeronautics

SATURDAY, OCTOBER 4

10:00 A. M. **AIRCRAFT**
F. M. Gruber, Chairman

The Designer and Manufacturing Costs - G. W. Papen, Lockheed Aircraft Corp.

Decimal Dimensioning - What Profit - O. E. Kirchner, American Airlines, Inc., and Chairman of SAE Committee S-1

10:00 A. M. **TRANSPORT**
E. C. Wells, Chairman

Operational Experiences on the Constellation:

Structures, Engines and Accessories - J. G. Borger and A. P. Elebash, Pan American Airways, Inc.

Supercharging, Handling and Loading Characteristics - R. C. Loomis, E. E. Cannady, and W. L. Harper, Trans World Airline

Operational Experiences on the DC-6:

Structures, Engines and Accessories - Marvin Whitlock, American Airlines, Inc.

Supercharging, Handling and Loading Characteristics - J. S. Martin, United Air Lines, Inc.

SAE

Section Officers

1947-1948

Baltimore

Chairman: **Herman Hollerith, Jr.**, materials engineer, Glenn L. Martin Co.

Vice-chairman: **J. R. Gourley**, general manager, United Automotive Service, Inc.; treasurer: **H. D. Neighbours**, partner, Air Brakes & Controls; secretary: **Richard D. Taber**, research engineer, American Hammered Piston Ring Division, Koppers Co.

Buffalo

Chairman: **Fredric Flader**, president, Fredric Flader, Inc.

Vice-chairman: **Bernard E. O'Connor**, assistant chief engineer, Houde Engineering Division, Houdaille-Hershey Corp.; secretary - treasurer: **Lloyd D. Bevan**, powerplant engineer, Bell Aircraft Corp.

Canadian

Chairman: **Edwin F. Armstrong**, chief engineer, General Motors of Canada, Ltd.

Vice-chairman: **Warren B. Hastings**, editor, Canadian Motorist; vice-chairman, Hamilton: **Frederick J. Beattie**, sales manager, Wallace Barnes Co., Ltd.; vice-chairman, Kitchener: **George W. Sawin**, president, B. F. Goodrich Co. of Canada, Ltd.; vice-chairman, Montreal: **George O. Clermont**, general manager, Clermont Motors, Ltd.; vice-chairman, Niagara Peninsula: **Charles Kemp Edward**, general purchasing agent, Atlas Steels, Ltd.; vice-chairman, Oshawa: **Emerson L. Chant**, project engineer, General Motors of Canada, Ltd.; vice-chairman, Quebec: **Col. Frederick W. Miller**, vice-president, Collins & Aikman of Canada, Ltd.; vice-chairman, Sarnia: **Gordon McIntyre**, manager, Technical Service Department, Imperial Oil, Ltd.; vice-

chairman, Windsor: **W. H. Cantelon**, general manager, Auto Specialties Mfg. Co. (Canada), Ltd.; treasurer: **William W. Taylor**, vice-president, Prest-O-Lite Battery Co., Ltd.; secretary: **Clifford E. Phillips**, sales manager, Perfect Circle Co., Ltd.

Chicago

Chairman: **Wilfred W. Davies**, superintendent, aircraft planning, United Air Lines, Inc.

Vice-chairman: **H. S. Manwaring**, manager of engineering, foreign operations, International Harvester Co.; vice-chairman, Aeronautics: **Raymond D. Kelly**, superintendent, engineering development, United Air Lines, Inc.; vice-chairman, Fuels & Lubricants: **William J. Backoff**, research engineer in charge of Automotive Laboratory, Pure Oil Co.; vice-chairman, Parts & Accessories: **Albert H. Winkler, Jr.**, senior engineer, Bendix Products Division, Bendix Aviation Corp.; vice-chairman, Passenger Cars: **Thomas A. Scherger**, engine development engineer, Studebaker Corp.; vice-chairman, Tractor & Diesel Engines: **Clarence A. Hubert**, manager of engineering, Farm Tractor Division, International Harvester Co.; vice-chairman, Transportation & Maintenance: **Frank W. Haase**, superintendent, motor equipment, Illinois Bell Telephone Co.; vice-chairman, Truck & Bus: **Russell H. Johnson**, chassis engineer, General American Aero-coach Co.; treasurer: **Paul H. Oberreutter**, president, Mid-West Dynamometer & Engineering Co.; secretary: **H. E. Churchill**, chief research engineer, Studebaker Corp.

Cincinnati

Chairman: **Ralph E. Morrison**, manager, Kelly Auto Body Co.

Vice-chairman: **Paul Klotsch**, chief engineer, Crosley Motors, Inc.; treasurer: **George Black**, development engineer, Trailmobile Co.; secretary: **William A. Kimsey**, engineer, R. K. LeBlond Machine Tool Co.

Cleveland

Chairman: **Robert Cass**, assistant to the president, White Motor Co.

Vice-chairman: **Norman Hoertz**, chief engineer, Service Division, Thompson Products, Inc.; vice-chairman, Akron-Canton: **Leland W. Fox**, manager, Tire Sales Engineering Division, Firestone Tire & Rubber Co.; vice-chairman, Aeronautics: **Addison M. Rothrock**, chief of research, National Advisory Committee for Aeronautics; vice-chairman, Transportation & Maintenance: **Oscar W. Smith**, automotive engineer, Socony-Vacuum Oil Co., Inc.; treasurer: **Robert F. Steeneck**, district manager (Cleveland), Fafnir Bearing Co.; secretary: **Albert E. Wilson**, vice-president in charge of engineering, Keal Industries.

Dayton

Chairman: **F. E. Lehman**, manager, sales and service, Aeroproducts Division, GMC.

Vice-chairman: **George W. Heck**, chief production engineer, United Aircraft Products, Inc.; vice-chairman, Columbus: **Dr. Frank C. Croxton**, supervisor of chemical research, Battelle Memorial Institute; vice-chairman, Springfield: **Noel Chapin**, lubricants engineer, Cities Service Oil Co.; treasurer: **J. E. P. Sullivan**, laboratory engineer, Airtemp Division, Chrysler Corp.; secretary: **David D. Bowe**, sales engineer, Aeroproducts Division, GMC.

Detroit

Chairman: **Robert Insley**, vice-president in charge of engineering, Continental Motors Corp.

Vice-chairman: **Ernest P. Lamb**, chief engineer, Truck Division, Chrysler Corp.; vice-chairman, Aeronautics: **Carl F. Bachle**, vice-president in charge of research, Continental Aviation & Engineering Corp.; vice-chairman, Body: **Rex A. Terry**, assistant chief engineer, Truck Division, Chrysler Corp.; vice-chairman, Junior Student: **E. K. Harris**, chairman, Drawing & Design Department, General Motors Institute; vice-chairman, Passenger Cars: **William S. James**, director of research, Ford Motor Co.; vice-chairman, Production: **Lawrence S. Martz**, account executive, Marvin Hahn Advertising; vice-chairman, Regional: **Charles S. McIntyre**, secretary, Monroe Auto Equipment Co.; vice-chairman, Saginaw Valley: **Earl R. Wilson**, resident engineer, Chevrolet-Flint Mfg. Division, GMC; vice-chairman, Truck & Bus: **Ralph K. Super**, brake division engineer, Timken-Detroit Axle Co.; treasurer: **Ferdinand W. Marschner**, western sales manager, New Departure Division, GMC; secretary: **Albert C. Hazard**, design engineer, Chevrolet Motor Division, GMC.

Hawaii

Chairman: **David H. Mikkelsen**, superintendent of automotive equipment, Honolulu Rapid Transit Co.

Vice-chairman: **Charles L. Eaton**, owner, Continental Trailer & Equipment Co.; vice-chairman, Aeronautics: **Stephen J. Miehlestein**, superintendent of maintenance, Hawaiian Airlines, Ltd.; vice-chairman, Maui: **Hollis A. Hardy**, assistant manager, Maui Motors; vice-chairman, Hawaii: **William O. Harper**, automotive superintendent, Kaiwili Sugar Co., Ltd.; treasurer: **Bill J. Eaves**, general manager, Coca Cola Bottling Co.; secretary: **John C. McLaughlin**, depot manager, Parts Division, U. S. Navy

Yards & Docks Supply Depot.

Indiana

Chairman: **William S. Powell**, vice-president, Laboratory Equipment Corp.

Vice-chairman: **Raymond A. Schakel**, manager, Automotive & Diesel Drive Division, Diamond Chain Co., Inc.; treasurer: **Wayne H. McGlade**, chief engineer, process engineering, J. D. Adams Mfg. Co.; secretary: **Robert P. Atkinson**, assistant turbine engineer, Allison Division, GMC.

Kansas City

Chairman: **William Erwin Briece**, branch manager, Pacific Airmotive Corp.

Vice-chairman: **Robert A. Walker**, director of aircraft engineering, Transcontinental & Western Air, Inc.; vice-chairman, Aeronautics: **Gus A. Seidel**, development engineer, Transcontinental & Western Air, Inc.; vice-chairman, Fuels & Lubricants: **L. J. Barney**, division automotive engineer, Socony-Vacuum Oil

Co., Inc.; vice-chairman, Transportation & Maintenance: **Howard F. Dougherty**, assistant shop foreman, Transportation Department, Kansas City Power & Light Co.; treasurer: **R. M. Sandford**, chemical engineer, Phillips Petroleum Co.; secretary: **Harold F. Twyman**, aeronautical engineer, Civil Aeronautics Administration.

Metropolitan

Chairman, **J. O. Charshafian**, assis-

SAE SECTION CHAIRMEN

Field editors have been asked to give readers vivid word pictures of their 1947-1948 chairmen. Here are the first of the new group.

If you know interesting, off-the-record facts about your Section chairman, confide them to your field editor . . . he'll do the rest.

CASS

. . . . of Cleveland

One of the most lucid discussers of technical topics among engineers of the country, British-reared Robert Cass came to his adopted country as an engineering instructor at Harvard University, and joined the engineering staff of White Motor Co. in 1925. His son is headed toward Harvard, too.

Urbane, he is an avid student of international affairs, has a literary bent of mind, and enjoys the opera and drama.

During the war, when on a mission with his company out along the tortuous Burma Road, he was reminded by Jap straffers of a World War I assignment when he taught Japanese cadets how to fly.

Graduating from Croydon School in 1912, he majored in engineering at London University, from which he was graduated in 1919, following an interruption of his studies by the war. He served in the Royal Naval Air Service as a chief petty officer, pilot, and instructor from 1915 to 1918.

After the Armistice Cass joined Short Bros., aircraft manufacturers in Rochester, Kent. He worked on various projects for that company until 1924 when he came to this country.

He progressed steadily in the White engineering department, becoming assistant chief engineer in 1938, was appointed chief engineer in 1941, and has been assistant to the president for the past few years.

MACDONALD

. . . . of British Columbia

H. D. (for Horace D'Orsay) Macdonald, new 1947-48 Chairman of the British Columbia Group, is a hard-working, painstaking and systematic administrator with ducks as a hobby but automotive maintenance as a passion. Sure . . . when the mallards hit the marshes of the Fraser River delta adjacent to Vancouver, the old musket comes out of storage. But if there's a chin-wag set for the same time on short or long stroke motors, the cannon goes back to the closet.

"Ted" (call him either of the names starting with H. and D. and you'll probably get hit with a spanner) is ably qualified for his new post spark-plugging the infant SAE group on Canada's west coast. A member since 1929, "Ted" bosses a fleet of motor vehicles for the British Columbia Police, a Pacific coast counterpart of the far-famed "Mounties" and one of the oldest law enforcement organizations on the continent. He joined the colorful constabulary in 1934 when the growing mechanism of the force necessitated supervisors with an intimate knowledge of motor vehicles. Today he is a mechanical supervisor of the Transport Branch of the B. C. police with headquarters at Vancouver.

Chairman Macdonald first poked his head beneath auto hoods when, at the age of sixteen, he joined the 19th

Company of the Canadian Army Service Corps in 1916. His age prevented him from service overseas in the first world conflict. But "Ted" did find what made the CASC's fleet of Cadillac ambulances tick; joined Vancouver's Begg Motor Co.—then Cadillac distributors—immediately following the armistice.

From Beggs, he moved to Bowell McDonald Motor Co. in 1932 as Service Manager. In 1932 he became mechanical supervisor of the Vancouver City Police; moved to New Westminster's Trapp Motors in 1933 and back again to Beggs immediately prior to joining the British Columbia Police in 1934.

Born in Prince Edward Island, he received his formal education in B. C. Thanks are due, he claims, to President "Teddy" Roosevelt for his nickname "Ted". Most Prince Edward Island parents borrowed the handle at the time when the famous Rough Rider was riding the height of his popularity.

In addition to the mechanical supervision of all rolling stock in the major supervisory district of the B. C. Police, the B. C. Group's Chairman is responsible for the inspection and approval of all school buses. Shortly after joining the force, he played a major role in the drafting of new regulations respecting the safety and mechanical qualifications of school and public passenger buses. During recent months, he has fathered the construction of new "mercy sleds" for use in British Columbia's rock-rimmed Fraser Canyon.

—by J. B. Tompkins, Field Editor.



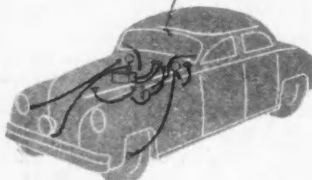
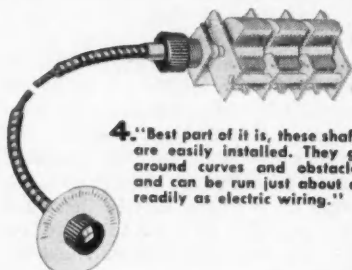


Robert Cass (right)
H. D. Macdonald (far
right)





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 <p>3. "In fact, these S. S. White flexible shafts give me a simple means of delivering rotary power or remote control from any point to any other point in a car, bus or truck."</p>	 <p>4. "Best part of it is, these shafts are easily installed. They go around curves and obstacles and can be run just about as readily as electric wiring."</p>

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Mid-Continent

Chairman: **Baxter L. Scoggin, Jr.**, manager, research and development, Anderson Pritchard Oil Corp.

Vice-chairman: **George W. Cupit, Jr.**, state chemist, Corporation Commission, State of Oklahoma; vice-chairman, Transportation & Maintenance: **Ed Rely**, shop foreman, transportation, Continental Oil Co.; treasurer, **Raymond G. Hilligoss**, manager, Bartlesville Bus Co.; secretary: **Roy E. Edwards**, research and development engineer, Halliburton Oil Well Cementing Co.

Milwaukee

Chairman: **Edwin E. Bryant**, vice-president, Nelson Muffler Corp.

Vice-chairman: **Gene D. Sickert**, works manager, Bolens Products Co.; treasurer: **Lt.-Col. Erich H. Lichtenberg**, research and patents, Koehring Co.; secretary: **George Haismaier**, sales manager, Young Radiator Co.

New England

Chairman: **Robert Gardner**, manager, Automotive Department, Lever Bros. Co.

Vice-chairman: **Elty C. Guion**, motor vehicle supervisor, New England Tel & Tel Co.; vice-chairman, Aeronautics: **Robert F. Lybeck**, manager, aviation sales, Colonial-Beacon Oil Co.; vice-chairman, Diesel Engines: **Ernest K. Bloss**, supervisor, diesel maintenance and operations, Boston & Maine Railroad and Maine Central Railroad; vice-chairman, Fuels & Lubricants: **Irving F. Richardson**, service engineer, Socony-Vacuum Oil Co., Inc.; vice-chairman, Passenger

Cars: **Alfred S. Hunt**, president, Hunt-Marquardt, Inc.; vice-chairman, Students: **Arnold R. Okuro**, head, Automotive Department, Franklin Technical Institute; vice-chairman, Transportation & Maintenance: **Clarence C. Eldridge**, owner, Eldridge Garage; vice-chairman, Truck & Bus: **Kingsley Cochrane**, foreman, Northeast Division, Motor Truck Repair Shop, Colonial-Beacon Oil Co.; treasurer: **John D. Works**, district manager, TEK Bearing Co., Inc.; secretary: **William F. Hagenloch**, president, Lenk, Inc.

Northern California

Chairman: **R. Wayne Goodale**, manager, Lubricants Division, Standard Oil Co. of Calif.

Vice-chairman: **Roy A. Hundley**, chief engineer, Enterprise Engineering & Foundry Co.; vice-chairman, Aeronautics: **Judson H. Pickup**, Pratt & Whitney powerplant engineer, Pan American Airways; vice-chairman, Diesel Engines: **Hans Bohuslav**, vice-president in charge of engineering, Sterling Engine Co.; vice-chairman, Fuels & Lubricants: **Lester W. McLennan**, supervisor, Union Oil Co. of Calif.; vice-chairman, Transportation & Maintenance: **Edward L. Kearney**, manager, Automotive Department, Tide Water Associated Oil Co.; treasurer: **William G. Nostrand**, chief engineer, Winslow Engineering Co.; secretary: **Harold R. Porter**, senior products engineer, Standard Oil Co. of Calif.

Northwest

Chairman: **Murray Aitken**, plant manager, Kenworth Motor Truck Corp.

Vice-chairman: **Russell E. Fleischer**, district manager, Colyear Motor Sales Co.; treasurer: **Paul P. Olson**, home office engineer, General Petroleum Corp.; secretary: **C. Fred Naylor**, acting division manager, Ethyl Corp.

Oregon

Chairman: **Earl B. Richardson**, superintendent of equipment, Portland Traction Co.

Vice-chairman: **John S. Poulson**, manager, Cummins Diesel Sales of Oregon, Inc.; vice-chairman, Aircraft: **Charles H. Lewis**, head fuels and lubricants engineer, Standard Oil Co. of Calif.; vice-chairman, Students: **W. H. Paul**, professor of automotive engineering, Oregon State College; treasurer: **Frank Costanzo**, owner, Frank Costanzo; secretary: **C. Art Dillinger**, manager, Tokheim Pump Agency.

Peoria

Chairman: **Richard S. Frank**, supervisor, general engine design, Caterpillar Tractor Co.

Vice-chairman: **Daniel B. Shotwell**,

research engineer, Caterpillar Tractor Co.; treasurer: **John W. Pennington**, staff engineer, Research Department, Caterpillar Tractor Co.; secretary: **Ivan E. Howard**, lubricants engineer, Phillips Petroleum Co.

Philadelphia

Chairman: **E. Robert Kinnebrew**, branch manager, White Motor Co.

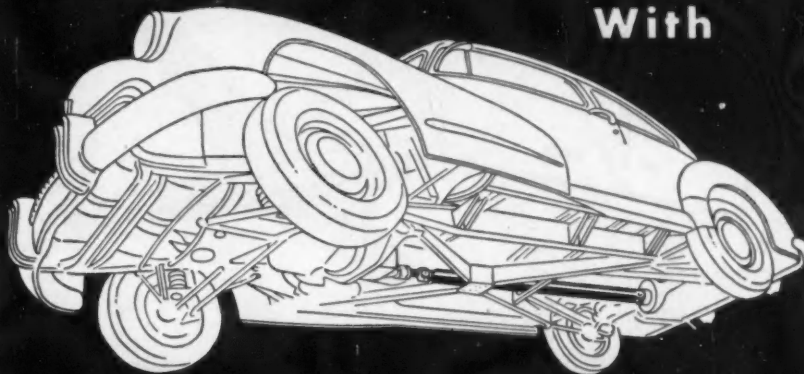
Vice-chairman, Aircraft: **Walter H. Pearson**, chief engineer, F. T. Griswold Mfg. Co.; vice-chairman, Fuels & Lubricants: **John R. Sabina**, technical director, Petroleum Chemicals

Division, E. I. duPont de Nemours & Co., Inc.; vice-chairman, Transportation & Maintenance: **Linn Edsall**, general superintendent, Transportation Division, Philadelphia Electric Co.; vice-chairman, Truck & Bus: **B. Frank Jones**, chief engineer, Autocar Co.; treasurer: **Leonard Raymond**, assistant supervisor, Automotive Division, Research Laboratories, Soco-Vacuum Oil Co., Inc.; secretary: **Parry H. Paul**, technical service engineer, Autocar Co.

Pittsburgh

Chairman: **Wallace Hallam**, dis-

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trict manager, Mack-International Motor Truck Corp.

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St. Louis

Chairman: **R. O. Slattery**, division

service engineer, Shell Oil Co., Inc.

Vice-chairman: **Adolph J. Jeude**, assistant chief engineer, design, Busch-Sulzer Bros. Diesel Engine Co.; vice-chairman, Aircraft: **Edmond Siroky**, development engineer, Wagner Electric Corp.; vice-chairman, Diesel Engine: **John A. Wich**, engineer, Busch-Sulzer Bros. Diesel Engine Co.; vice-chairman, Fuels & Lubricants: **August H. Blattner**, assistant chief draftsman, Carter Carburetor Corp.; vice-chairman, Transportation & Maintenance: **Howard M. Parkes**, director of maintenance,

Complete Auto Transit, Inc.; treasurer: **Roy T. Adolphson**, Sonnen Products Co.; secretary: **Walter E. Lang**, service engineer, Acheson Colloids Corp.

San Diego

Chairman: **Joseph H. Famme**, project engineer, Consolidated Vultee Aircraft Corp.

Vice-chairman: **Daniel S. Sanborn**, research engineer, McCulloch Motors, Inc.; secretary-treasurer: **D. R. Thomas**, design engineer, Consolidated Vultee Aircraft Corp.

Southern California

Chairman: **L. D. Bonham**.

Vice-chairman: **James W. Sinclair**, manager, Automotive Department, Union Oil Co. of Calif.; vice-chairman, Aircraft: **Luther P. Spalding**, chief research engineer, North American Aviation, Inc.; vice-chairman, Aircraft Engines: **Melvin N. Laffer**, supervisor of engineering, Powerplant Division, Menasco Mfg. Co.; vice-chairman, Air Transportation: **Paul C. Swan**, technical liaison engineer, Sales Division, Douglas Aircraft Co., Inc.; vice-chairman, Diesel Engines: **Edward M. Bonette**, salesman, Cummins Service & Sales; vice-chairman, Fuels & Lubricants: **Claude E. Emmons**, technologist, Texas Co.; vice-chairman, Passenger Cars: **Wellington E. Miller**, owner, "Automobile Design Creator," Library of Vehicles; vice-chairman, Production: **Stanley Wilson**, junior manager, Burbank Branch, Pacific Airmotive Corp.; vice-chairman, Transportation & Maintenance: **August F. Schulze**, foreman, Transportation, Consolidated Vultee Aircraft Corp.; vice-chairman, Truck & Bus: **Joseph C. Gill**, factory representative, White Motor Co.; treasurer: **Robert L. Johnson**, garage superintendent, City Hall Garage, City of Los Angeles; secretary: **Frank Radovich**, assistant manager, California Testing Laboratories, Inc.

Southern New England

Chairman: **Richard C. Molloy**, executive research engineer, United Aircraft Corp.

Vice-chairman: **David E. Waite**, contact engineer, Wallace Barnes Co.; vice-chairman, Aeronautics: **W. P. Eddy, Jr.**, chief of engineering operations, Pratt & Whitney Aircraft; treasurer: **Henry J. Fischbeck**, supervisor, metallurgical and chemical processing, Pratt & Whitney Aircraft; secretary: **Claude O. Broders**, designer, Pratt & Whitney Aircraft.

Spokane-Intermountain

Chairman: **George A. Jackman**, superintendent of maintenance, United Truck Lines, Inc.



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Syracuse

Chairman: **John L. Collins**, assistant general manager, New Process Gear Corp.

Vice-chairman: **Samuel K. Wolcott, Jr.**, engineer in charge of engines and pumps, American LaFrance Foamite Corp.; vice-chairmen, Elmira: **David Gundry**, chief engineer, Ward LaFrance Truck Division, Great American Industries, Inc. and **E. E. Baldwin**; treasurer: **Carl T. Doman**, vice-president in charge of engineering, Aircooled Motors Corp.; secretary: **Curtis R. Armbrust**, products engineer, Easy Washing Machine Corp.

Texas

Chairman: **Floyd Patras**, manager of maintenance, Southwestern Greyhound Lines, Inc.

Vice-chairman, Dallas & Fort Worth: **Ross Peterson**, director, vice-president, Texas Trade School; vice-chairman, Houston: **Claude D. Peebles**, superintendent of transportation, United Gas Corp.; treasurer: **James W. Walker**, director, Walker Laboratories; secretary: **John T. Wade**, superintendent, auto equipment, Texas Power & Light Co.

Twin City

Chairman: **Thomas C. Hendrickson**, division lubricants engineer, Pure Oil Co.

Vice-chairman: **J. C. Holby**, chief engineer, D. W. Onan & Sons, Inc.; treasurer: **Paul F. Shivers**, design engineer, Minneapolis-Honeywell Regulator Co.; secretary: **Frank A. Donaldson, Jr.**, vice-president, Donaldson Co., Inc.

Washington

Chairman: **Hoy Stevens**, in charge of equipment and maintenance, American Trucking Associations, Inc.

Vice-chairman: **E. K. Owens**, field engineer, U. S. Rubber Co.; treasurer: **Bertram Ansell**, partner, Ansell & Goda; secretary: **Herbert A. Roberts**, president, Roberts Bros. Co.

Western Michigan

Chairman: **Paul Fuller**, project engineer, Continental Motors Corp.

Vice-chairman: **G. Waine Thomas**, assistant chief engineer, Automotive Division, Continental Motors Corp.; treasurer: **Marion C. Travis**, special assignment engineer, Sealed Power Corp.; secretary: **Willis R. Johnson**, sales engineer, Campbell, Wyant & Cannon Foundry Co.

Wichita

Chairman: **Harold W. Zipp**, chief

engineer, Wichita Division, Boeing Airplane Co.

Vice-chairman: **Walter E. Burnham**, staff engineer, research, Beech Aircraft Corp.; treasurer: **M. L. Carter**, research chemist, Southwest Grease & Oil Co.; secretary: **Marvin J. Gordon**, aerodynamics engineer, Beech Aircraft Corp.

British Columbia Group

Chairman: **Horace D'Orsay MacDonald**, mechanical supervisor, Transport Branch, British Columbia Police.

Vice-chairman: **Harold Puxon**, man-

aging director, Columbia Trailer Co., Ltd.; treasurer: **Frank Davison**, chief engineer, Industrial Engineering Co., Ltd.; secretary: **Burdette Trout**, sales, Truck Parts & Equipment, Ltd.

Colorado Group

Chairman: **Merle J. Webber**, sales-service manager, Central Supply Co.

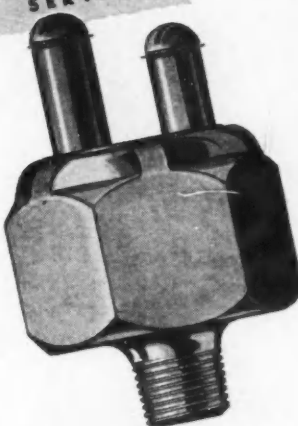
Vice-chairman: **Kenneth G. Custer**, assistant, Technical Division, Gates Rubber Co.; treasurer: **Edgar Lee Elder**, owner, Elder Trailer & Body Service; secretary: **Richard S. Arnold**, owner, Kwickway Tool Co.

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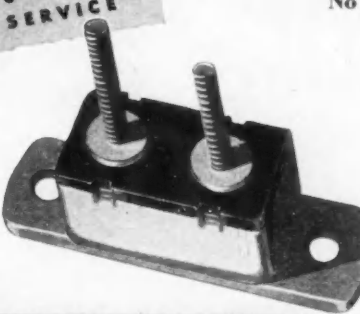
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Vice-chairman: **Robert H. Craig**, car sales manager, Albany Garage; secretary-treasurer: **Edgar I. Billings**, sales engineer, Socony-Vacuum Oil Co., Inc.

Salt Lake Group

Chairman: **Clark E. Smith**, general garage foreman, Burlington Transportation Co.

Vice-chairman: **David Brown**, parts

department manager, Cummins Inter-mountain Diesel Sales Co.; secretary-treasurer: **Frank G. Backman**, manager, Midwest Service & Supply Co.

Virginia Group

Chairman: **Lucien W. Bingham**, partner, Bingham Truck Service.

Vice-chairman: **Paul R. Lauritzen**, president, Lauritzen Motors, Inc.; treasurer: **E. Govan Hill**, president, Automatic Shifters, Inc.; secretary: **J. D. Lawrence, Jr.**, manager, National Oil Corp.

Williamsport Group

Chairman: **Walter C. Jamouneau**, chief engineer, Piper Aircraft Corp.

Vice-chairman: **G. Allan Creighton**, special problems engineer, Lycoming Div., Aviation Corp.; treasurer: **Robert B. Ingram**, assistant supervisor engineer, Aviation Corp.; secretary: **Ralph S. Wilson**, experimental test engineer, Lycoming Div., Aviation Corp.

Applications Received

The applications for membership received between July 10, 1947, and Aug. 10, 1947, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: John Beasley Myers, D. Merle Walton.

British Columbia Group: Ray M. Higgins, Phillip McGarvie.

Canadian Section: J. Bernard Laviguer.

Chicago Section: Glen E. Foote, Louis Edward Hart, Richard C. Korff, Charles W. Lyman, Jr., Donald Eugene Sterling, Robert Irvin Traver, George Alfred Underwood, Jr., Donald George Wierman.

Cincinnati Section: Emery F. Comstock.

Cleveland Section: George J. Atoulikian, Harvey R. Berghaus, William Dale Edwards, Robert J. Killian, George Boswell Moseley, Jr., Clifford A. Reimer, John A. Turkopp, Jr.

Dayton Section: Grover Henry Detmer, John Warren Harrison, II, John Will-young Janson, Leslie H. Markham.

Detroit Section: Robert B. Alexander, Winston H. Ambrose, James D. Cannon, William J. Crawford, III, John B. Dickson, Willis Arthur East, Robert G. Evans, Arthur P. Ferguson, Robert E. Fidler, Frederick Carl Foshag, David Roger Glass, Weston Rowley Hutchins, Thomas David Kosier, Edward Koczat, John A. Manoogian, Harold Johnston Morris, Robert William Platt, William J. Reid, Herbert Otto Heinrich Schmidt, Lloyd Winston Schuhmann, Stewart W. Schulmeyer, John L. Searle, William Walter Smith, Thomas Jellison Wall.

Hawaii Section: Kenton A. Alchele, Vernon F. Beebe, Earl Stanley Elmore, David A. Fleming, M. Russel Fozzy, John Ross Hughes, Henry E. Meyer, Hymie J. Meyer, Jr., Marco M. Meyer, E. Butler Smith, Lyle M. Van Dreser, M. G. Watson.

Metropolitan Section: John E. Davis, William R. Cisney, Alberto Marx, Clyde A. Parton, Jules J. Reynaud, John J. Schauble, Frank A. Tedesco, Warren Philip Westbo.

Mid-Continent Section: Travis L. Gordy.
Milwaukee Section: Russell E. Baetke, Richard L. Heinrich, Paul W. Latham, Jr., John Thomas Nadolny, Charles M. Zimney.

Indiana Section: Charles Mark Middle-

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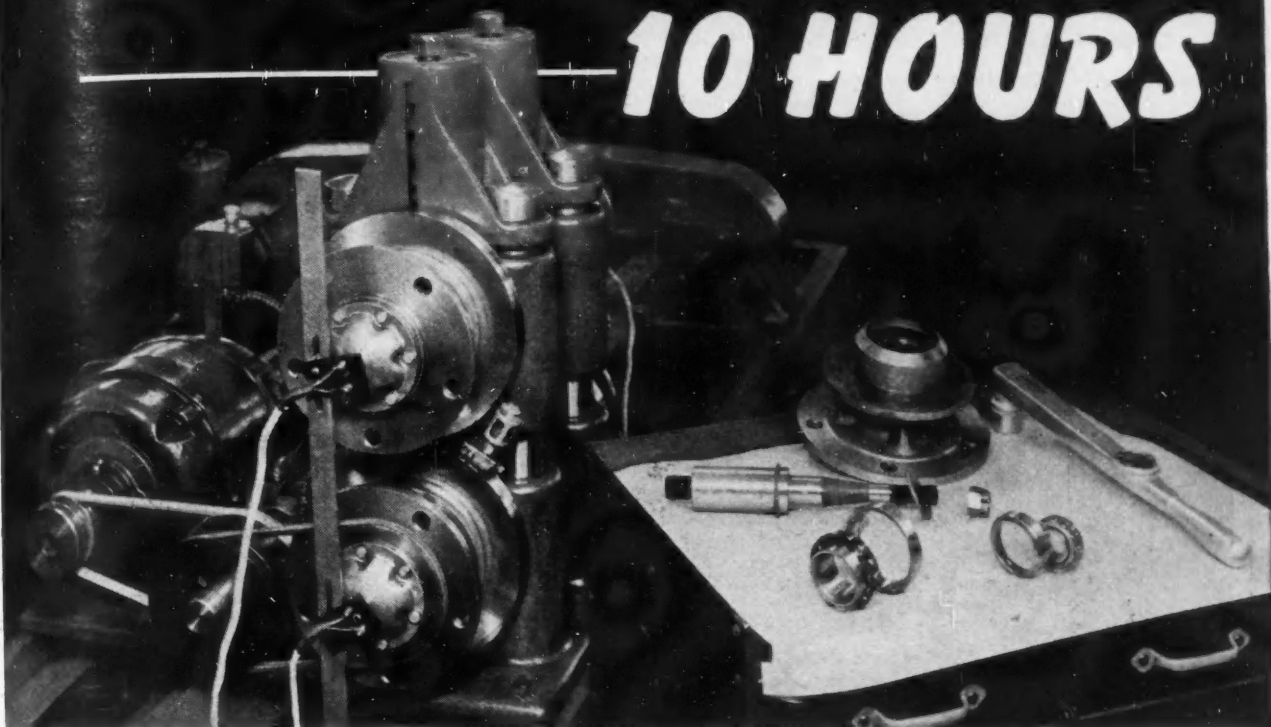


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worth, W. O. Sweeny, Armand L. Thielker.

Kansas City Section: John W. Vale, Jr.

New England Section: Theodore H. Eliades, Elton Hammond Tucker, John S. Witmer.

Northern California Section: Eldon C. Beagle.

Northwest Section: Miss Betty LaRue Bunte.

Oregon Section: John Read Hulbert, Jr.

Peoria Section: Robert Richard Brian Backlund.

Philadelphia Section: Joseph A. Daley, Jr., Zdzislaw W. Klikunas.

Pittsburgh Section: Edwin W. Booth, Alfred Bing Drastrup, Samuel R. Lloyd.

St. Louis Section: Victor Millman, Ernest S. Robson, Jr., John L. Werner.

San Diego Section: Donald E. Lovelace.

Southern California Section: Charles A.

Adolph, Jr., Eugene E. Finch, Harry R. Gaynor, Wendall M. B. Haas, Verne M. Hill, John Richard High, Duncan K. MacLennan, Gilbert Russell Moore, Daniel Milton Tenebaum, John F. Whitmore.

Southern New England Section: Russell Frederick Bray, Jr., Richard Cranleigh Mulready, Robert K. Skrivseth, Robert Ernest Tschirch.

Spokane-Intermountain Section: M. Conner Ahrens, Fulton Clement McInerney.

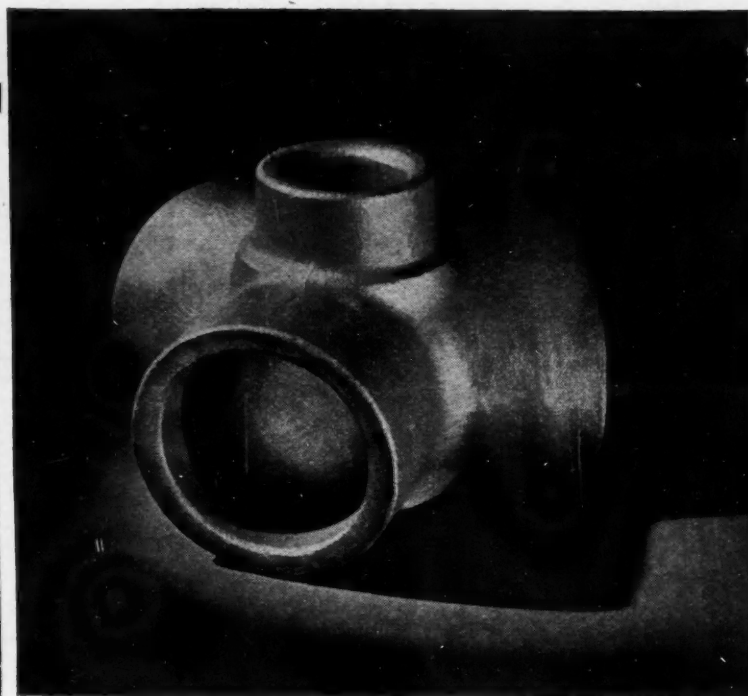
Texas Section: John F. Dickmann, John D. Dupy, Frank M. Jobes, William E. Sperman, E. J. Strawn, George C. Younie.

Twin City Section: Leonard Mayeron, Harry W. Woodis.

Wichita Section: Mark E. Taylor.

Outside of Section Territory: Sam T. Crawford, Jr., William P. Hilliker, Frank Joseph Roehrenbeck, Jr., Gordon L. Scofield.

Foreign: British European Airways, England; William Glenn Burket, South Africa; Richard Neville Clark, England; Prof. Antonio Fessia, Italy; Leonard C. Fisher, Australia; Venceslas Figl, M. E., Czechoslovakia; Edwin Haswell Moyes, England; Edward Victor Nurse, England; Chandra Bhushan Saran, India; William Sparrow, England; Errol Graham Williams, Australia.



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New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between July 10, 1947, and August 10, 1947.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: Robert G. Clark (J).

British Columbia Group: Roy H. Johnston (A), Arthur Albert Stiffe (A), Prof. J. R. W. Young (M).

Canadian Section: Emmanuel E. Chauvin (A), P. M. Jackson (A), Mansell Herbert Moore (A), Edwin Lloyd Parsonage (A), Wilbur James Tate (A).

Chicago Section: Clayton F. Britton (M), Robert Frank Ettinger (J), Donald G. Ewing (A), Howard H. Kehrl (J), Cloyd L. Lawrence (A), Raymore D. MacDonald (M), William C. Musham (M), F. A. Ronzheimer (A), Thomas A. Smith (J), George H. Webb (A).

Cincinnati Section: John J. Beckstedt (M).

Cleveland Section: William Elmer Brill (M), Elmer A. Kemp (M), Carl F. Koenig (M), Alexander Winton, Jr. (A).

Dayton Section: George Ullman Crites (M), Donald E. Danielson (J), Robert L. Fritsch (J), Jacob Joseph Giancola (A), Richard F. Gompertz (SM).

Detroit Section: Henri Emile Biraben (FM), Richard C. Cook (M), Vaughn Randall Groom (J), Capt. Richard G. Illing (J), Sigurd M. Kildal (J), Harold H. Klein (A), John MacDougall (J), E. O. Reynolds (M), William F. Rossiter (A), Walter J. Ruessman (J), John W. Wade (J), Lloyd E. Webb (M).

Hawaii Section: Leonard H. Anderson (A), Lewis S. McClure (A), Alfred L. Storm (A).

Indiana Section: E. Crowell Knight (M).

Metropolitan Section: J. E. Campbell (A), Howard Day Chapin (J), Clinton F. Egerton (J), Frank J. Graf (M), Niilo V. Hakala (J), Howard G. Ingerson, Jr. (J), Harvey S. King (A), D. Marshall Klein (SM), Ernest Lagelbauer (M), Louis Morda (SM), Joseph T. Ratau (J), Charles A. Schweitzer (J), Wallace W. J. Skinner (A), Robert L. Stalard (J), Jack Yampolsky (J).

Mid-Continent Section: James O. Chase (J), Merl D. Creech (M).

Milwaukee Section: George Y. Anderson, Jr. (M), Walter J. Foley (M), Herbert A. Guntow (J).

New England Section: Robert Allerton Prisch (J), Robert M. Zimmerman (M).

Northern California Section: Martin J. Duffy (A), Stanley R. Piaggi (A), Vin-ton Curtis Ryland (A).

Northwest Section: Stuart J. McTaggart (J), Davis M. Wood (M).

Philadelphia Section: Ernest Fowler Marshall (J), George W. Marshall, Jr. (A), H. Barker McCormick, Jr. (J), Thomas Reynolds Pierpoint (J).

Pittsburgh Section: Oliver B. Rosstead, Jr. (J).

St. Louis Section: John Thomas Harrington (J).

Salt Lake Group: Clyde William Sissman, Jr. (J).

San Diego Section: Grant B. Hodgson (M), Burt F. Raynes (A).

Southern California Section: Karl D. Breitigan (A), Pierce F. Clarke (J), William Glenn Ebersole (A), W. J. Elgar (A), Frederick Hammond Green (M), Glynn H. Lockwood (J), Robert G. Strother (A).

Southern New England Section: Frank De-

Luca (M), Randolph P. Dominic (J), Glenn Maynard Douglass (J).

Spokane-Intermountain Section: Otto R. Fogle (A).

Syracuse Section: Ernest F. Ling (M).

Virginia Group: Chas. John Ahrens (A), Earle Randolph Cournow (A), Malcolm J. Gowen (A), Albert G. Griffin (A), C. Dimmock Jenkins (A), George D. Thomas (A).

Washington Section: Ralph R. Elder (A).

Outside of Section Territory: Charles The-ron Grace (M), Major Chet D. Hirsch (A), Gordon MacLean (J).

Foreign: Jean-Jacques Baron (FM), France; Walter Richard Berry (FM), England; Philip Byron Burden (FM), Australia; Charles Harold Fisher (FM), England; Giuseppe Gabrielli (FM), Italy; Oliver Dennis Gibbon (A), British West Indies; R. A. Nariel-wala (FM), India; Nils E. Nystrom (FM), Sweden; Cheng-Wen Tien (FM), China.



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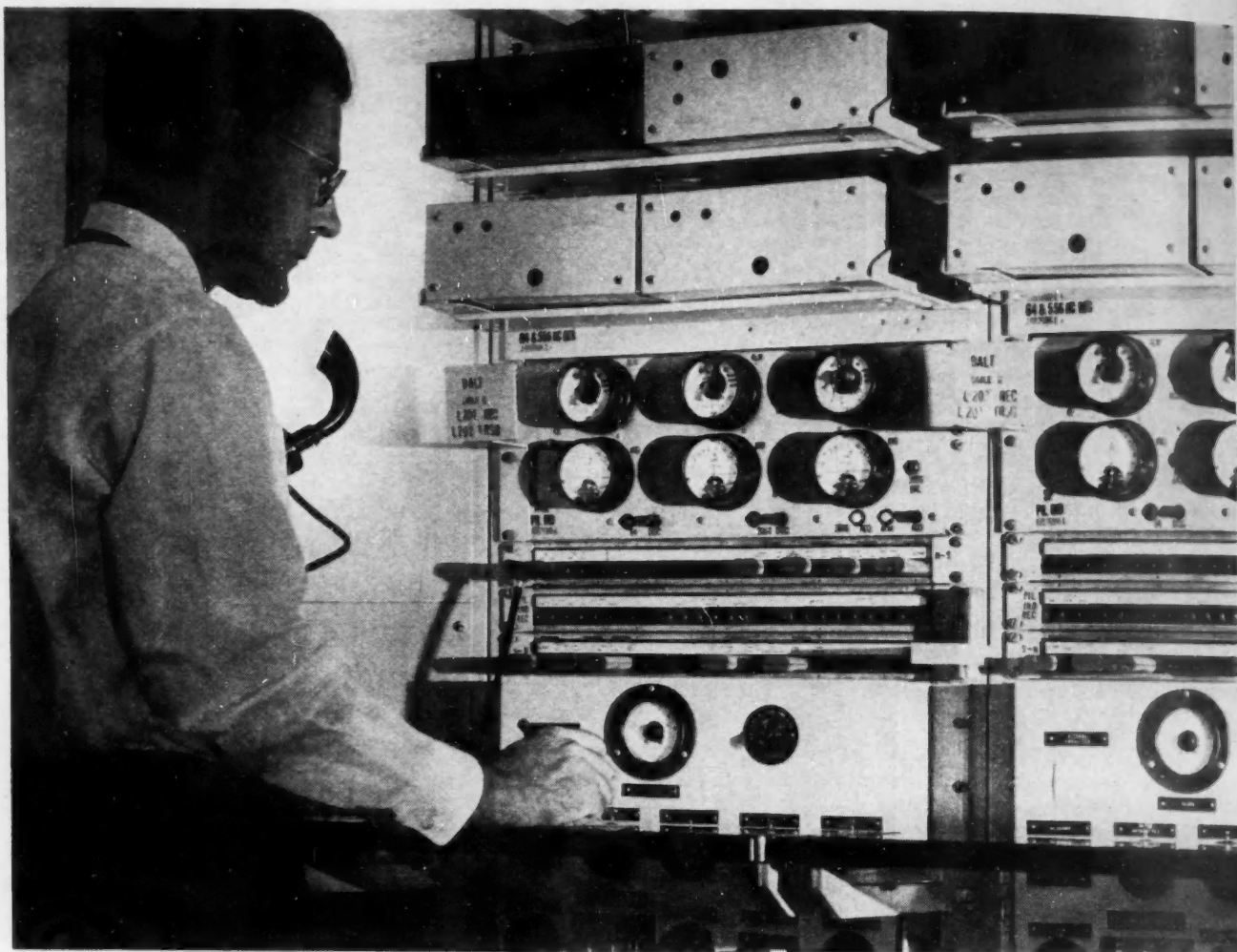
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self-regulating in telephone systems. This is one reason why your long distance call goes through clearly, summer or winter.

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